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DISEASES DUE TO PROTOZOAN PARASITES.*

LANFRANCHI (Alessandro) & SANI (Luigi). **L'intrapalpebro-reazione nella diagnosi del Morbo Coitale Maligno.** [Intrapalpebral Reaction in the Diagnosis of Dourine.]—*Bull. Soc. Path. Exot.* 1921. July 13. Vol. 14. No. 7. pp. 374–378.

In 1915 these authors, in a preliminary note, referred to the results obtained by the intrapalpebral method of testing horses affected with surra, and they claimed that the reaction not only enabled them to detect the presence of the disease, but also to differentiate it from nagana.

Recently, dourine has become a somewhat serious problem among breeding-horses in Italy, and in this paper experiments are described in which the efficacy of the intrapalpebral reaction in the diagnosis of this disease was tested. The authors utilized as antigen a preparation of trypanosomes obtained in the pure state, viz., *T. brucei* and the virus "Lanfranchi." These trypanosomes were separated from the blood corpuscles by adding to the blood a haemolytic serum. They were then emulsified in pure glycerine (in the proportion of one to three), or in glycerine and normal saline solution, or in distilled water. In the case of infected animals the reactions obtained were almost similar to those observable in the case of a positive reaction to mallein. Swelling of the eyelids became manifest from the 3rd or 4th hour onwards, and attained its maximum in from the 12th to the 18th hour. It then slowly diminished in size and remained appreciable up to the 36th hour. A slight temperature reaction was usually noticeable, together with more or less marked local symptoms, such as photophobia and lachrymation. Animals which were undergoing treatment exhibited a local swelling, which developed more rapidly and reached its maximum towards the 10th or 11th hour and disappeared in 20 to 24 hours. The temperature reaction was also less noticeable. In the case of healthy animals the local reaction was almost comparable to that seen in animals undergoing treatment, but the temperature reaction and the other symptoms could usually be observed.

It will doubtless be possible, the authors claim, by utilizing *T. equiperdum* as antigen to obtain results of a practical interest.

* Mr. J. T. Edwards left for India without having the opportunity of seeing the final proofs of this number.—ED.

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NATTAN-LARRIER (L.). **Infections par *Trypanosoma equiperdum* chez la souris et chez le rat.** [*T. equiperdum* Infections in the Mouse and Rat.]—*Bull. Soc. Path. Exot.* 1921. July 13. Vol. 14. No. 7. pp. 433–442.

The dourine trypanosome, as was shown by the investigations of ROUGET and of SCHNEIDER and BOUFFARD, is sometimes virulent for the mouse and rat, and sometimes quite harmless for these animals. The virulent types, however, rarely lose their activity, whereas the harmless ones may become virulent, and again this acquired property of virulence may be readily lost. It thus results that the virulence of *T. equiperdum* cannot be fixed as in the case of *T. brucei* and *T. evansi*. These properties in the dourine trypanosome were studied by Nattan-Larrier in a strain obtained from MESNIL'S laboratory in 1912. A series of passage experiments performed on mice and rats during the course of the succeeding two years is described in this memoir.

Briefly, the results were that the virus, which was at first only feebly pathogenic for mice, became readily and rapidly exalted in virulence during the course of these transmission experiments, until finally it became markedly potent. Its virulence thenceforward appeared to remain fixed for a period extending over more than a year, when the experiments were discontinued. In both the mouse and the rat, remissions during the course of infection became observable only when the virus had attained moderate activity. These types of infection made a sudden appearance during the course of the transmission experiments and were manifested with varying frequency over a period which varied somewhat in duration; these forms then disappeared, and later were reproduced again for no apparent reason.

As the virus assumed greater activity in the mouse it increased proportionately in virulence for the rat, and the same appeared to apply to the guinea-pig.

Infection with the trypanosome would appear to be capable of setting up subcutaneous swellings in the head region of the mouse, recalling somewhat those seen by ROUGET in the rabbit. However, it would seem that more frequently veritable sharply circumscribed "plaques" were set up in the rat as characteristic lesions, thus presenting an analogy with the skin lesions seen by ROUGET in infected dogs.

PRICOLO (Antonio) & FERRARO (Giuseppe). **Identificazioni dei Trypanosomi della Colonia Eritrea.** [The Identity of the Trypanosomes in the Italian Colony of Eritrea.]—*Clinica Vet.* 1920. Feb. 29. Vol. 43. No. 4. pp. 111–123.

In this article the authors present a studious review of the trypanosome question in Northern Africa as the outcome of some controversial statements made by DI DOMIZIO with regard to the identity of the trypanosomes which they claimed to have observed in the domesticated animals of Eritrea. In Eritrea, the authors conclude, two species of trypanosomes may be encountered, viz., *T. evansi* in camels and equines, and *T. vivax* (*vivax-uniforme*) in cattle. In natural circumstances, *T. evansi* could not be found in cattle and *T. vivax-uniforme* could not be demonstrated in camels or equines.

However, it would seem that the camel is susceptible to infection with *T. vivax*, and in support of this statement the results of one

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experiment are given. A camel, known to be free from trypanosomes by direct examination of the blood and inoculation of its blood into rats and sheep, was inoculated subcutaneously with 100 cc. of blood from a trypanosome-affected ox. Fourteen days after the inoculation, the camel's blood on direct examination showed numerous trypanosomes, which were found to be not infective for the rat, but infective for a lamb. The infestation was ephemeral, for a few days later the trypanosomes disappeared from the blood and were not subsequently observable. The camel died later as the result of some other disease. This would appear to be the only record in the literature of infection of the camel with *T. vivax*.

MARTOGLIO appears to have claimed that the camel is not susceptible to *vivax* infection.

DI DOMIZIO (Giovanni). **Su due Tripanosomi del Bestiame nella Somalia Italiana.** [Two Trypanosomes of Cattle in Italian Somaliland.]—*Bull. Soc. Path. Exot.* 1921. July 13. Vol. 14. No. 7. pp. 423–433.

In his original studies upon the trypanosomiases of Italian Somaliland, MARTOGLIO (F.), 1911, described (1) an affection, known to the natives under the name *Salaf*, peculiar to the camel and identifiable with surra; (2) *Ghindi*, affecting all the domesticated animals in the colony; and (3) *Gobiat*, restricted to cattle, at least as a natural disease and attributable to two different causal organisms, which he named, respectively, *T. somalilense* and *T. cellii*. Subsequently, as the result of observations made upon the same question, CROVERI (P.), 1919, confirmed MARTOGLIO'S statement with regard to the nature of *Salaf* in camels and with regard to the existence of *Ghindi* in all the domesticated animals, but maintained that the causal organism of this particular affection was not a new species, but could be identified closely with "*T. dimorphon.*" This author, however, failed to obtain confirmation with regard to the existence of *Gobiat* as an etiologically distinct morbid entity. During a period extending over more than a year, Di Domizio had occasion to examine numerous cases of trypanosomiasis both in cattle and horses in Italian Somaliland, and in these very common affections he was at the outset struck with the very marked morphological differences exhibited by the trypanosomes in the circulating blood of cattle and of horses affected with the disease known to the natives as *Ghindi*. These differences are clearly described, and the pathogenic characters of the two trypanosomes were also examined. It would appear to be incontestably established thereby that the trypanosome which was so markedly pathogenic for cattle belonged to the so-called "*dimorphon-congolense*" type, whereas the dimorphic or rather polymorphic trypanosome found in equidae was of the "*brucei-pecaudi*" type.

[In discussing this question, Di Domizio appears to accept the views of BRUCE and his collaborators, which, moreover, have been confirmed by the researches of BLACKLOCK and YORKE and DELANOE, that the trypanosomes named *dimorphon*, *congolense*, and *pecorum* constitute a single species, to which the name *T. pecorum* was given by BRUCE himself, while *T. nanum* appears to be simply a variety. In French and Italian writings there appears to be a persistent and obstinate tendency to retain the name "*dimorphon*" for this particular trypanosome, following the lead apparently of MESNIL, who relegated this

name, originally invented by DUTTON and TODD for the trypanosome seen by them in Gambian horse sickness, to the small monomorphic trypanosome, which he subsequently fixed as a definite species on account of its morphological characters, present in this affection. It would be well if this name "*dimorphon*" were now dropped, as it is misleading when applied to an organism characterized by its monomorphism. Moreover, there appears to be doubt as to the need for keeping alive the name "*pecaudi*."—J. T. E.]

The alleged new species of trypanosomes described by MARTOGLIO under the names *T. somalilense* and *T. cellii* would appear to be merely attributable to mixed infections produced by both the above organisms and probably also to a third species of the *cazalboui* [*vivax*] type.

[The observations recorded by the authors thus appear to lend more and more support to the simple classification of the African trypanosomes, originally established by BRUCE, whereby all would appear to appertain either to (1) the *T. brucei* type, (2) the *T. congolense* (*pecorum*) type, and (3) the *T. vivax* type.—J. T. E.]

SCHEIN (Henri). **Coccidiose des Ruminants dans le Sud-Annam.** [Coccidiosis in Ruminants in Southern Annam, French Indo-China.]—*Bull. Soc. Path. Exot.* 1921. July 13. Vol. 14. No. 7. pp. 380–382.

Goats in the neighbourhood of Nhatrang are very frequently infected with a coccidium, probably *Eimeria arloingi*, identical with the organism described by VELU, in Morocco. Although almost all goats are infected, deaths are only produced in young animals suffering from debility at the time of weaning or during the rainy season, or as the result of intercurrent disease. In the winter of 1920–21, the disease became more serious than usual, and was particularly marked in goats infected experimentally with rinderpest. The animals suffered from profuse diarrhoea, sometimes blood-tinged, anaemia and rapid wasting. Post-mortem lesions could only be found in several parts of the small intestine; the mucous membrane was congested, thickened, and sometimes showed ulcers. There were also seen small, caseous-like masses from about the size of a millet seed to a rice grain. Sections examined histologically at these points showed a rich invasion with coccidia (young merozoites particularly) and destruction of the epithelium. On rare occasions sporulating oocysts were found in the faeces. On keeping the faeces in a moist chamber for a few days the proportion of segmented parasites became greater. The sporulating oocysts were ovoid in shape, 16–23 μ long by 12·5–17 μ broad, and contained four sporozoites, but no residual body. Each sporoblast was ovoid and measured 10 by 5 μ. It contained two sickle-shaped sporozoites about 2·5 μ in maximum width. No residual body could be seen. A strange feature about this enzootic is that the Nhatrang goats are raised on the seashore in a very dry, sandy district, which *a priori* would not seem to be favourable for the spread of the disease. However, goats and even adult goats, brought down from the more humid, mountainous regions frequently contract on arrival severe coccidiosis, which often kills them, even in summer, when there is but little rain.

A certain degree of tolerance towards infection would thus appear to be set up in young animals exposed to the disease from their early

days. There are very few sheep in the district, and none of these appear to show any signs of coccidiosis.

The author also observed the presence of a coccidium, quite indistinguishable in appearance from the above, in calves and young buffaloes, which reacted to a rinderpest inoculation and showed severe intestinal symptoms. Healthy animals did not show these organisms, but it is probable that they might be carriers. The coccidia from the goat appeared, however, to be somewhat larger, and sporulated more quickly than those of calves and young buffaloes. SCHULTZ (C. H.) (see this *Bulletin*, 1915, Vol. 3, No. 3, p. 101) has already drawn attention to the fact that acute coccidiosis may be set up in cattle following upon the injection of rinderpest blood. Schein therefore suggests that in districts in which coccidiosis is enzootic it would be wise to increase the dose of anti-serum in preventive inoculation against rinderpest, and also to attempt treatment of the coccidiosis simultaneously.

CURASSON (G.). **Coccidiose de la chèvre en A.O.F.** [Coccidiosis of the Goat in French West Africa.]—*Rec. Méd. Vet.* 1921. March 30. Vol. 97. No. 6. pp. 129–130.*

This disease was first studied by MAROTEL in 1905, and has since been observed by various authors. Within recent years, Curasson encountered it with comparative frequency in the Soudan and in Senegal. He states that the disease has a seasonal distribution, appearing shortly after the commencement of the rainy season and abating when the dry weather becomes established. Young animals in particular are affected, and always very severely. It is rare for a kid showing diarrhoea and wasting to survive longer than 15 days. As many as 26 deaths occurred among 31 kids which the author attempted to treat in 1919–20. Contrary, however, to the experience of VELU, in Morocco, Curasson noticed quite a number of adult animals sufficiently affected to cause marked softening of the faeces and distinct wasting. Two old animals that died were found, on post-mortem examination, to be badly infested.

The first symptoms of illness noticed in the young animal are dullness, a tendency to remain isolated from the rest and rapid wasting. Coincidently, diarrhoea is observed, which becomes more marked; the animal lies down frequently, and finally remains recumbent. Death usually occurs in 12–15 days. Nervous symptoms are often seen, commencing usually about the day before death takes place. They do not take the form of simple convulsions preceding the death of the animal, such as are described by VELU, but are a definite train of symptoms which can easily be seen by making the affected animal rise. It staggers, sways on both fore and hind limbs, hangs its head, and, on beginning to walk, describes an arc of a circle of varying diameter, after which it falls down. If made to rise again, it repeats the process. It pushes against a wall or other obstacle that it may encounter. Before he was aware of the existence of this disease, the author was inclined to attribute these symptoms to an intoxication, on account of their analogy with those set up by eating the so-called "death plant" of the Bambara tribe. Later, however, he succeeded in reproducing them in kids by experimental infection with coccidia, and thus they are no doubt caused by the disease itself.

* Abstracted by Mr. T. J. Bosworth, B.Sc., D.V.S.M., M.R.C.V.S.

Treatment is apparently useless. Drugs that were tried without success were emetin, hordenin, intestinal antiseptics and galyl.

Affected animals should be slaughtered and measures taken to prevent infection of the healthy. Pastures known to be infected and all damp pastures are to be avoided. In Senegal it is especially necessary to prevent the animals drinking from the large pits dug by the natives to catch water during the rainy season, which rapidly become polluted with human and animal excreta, and are thus an abundant source of flukes, strongyles, coccidia, and probably many other harmful parasites.

CROVERI (Paolo). **La sarcosporidiosi bovina nella Somalia italiana Suoi rapporti colla deficienza di nutrizione, peste bovina e tripanosi.** [Bovine Sarcosporidiosis in Italian Somaliland. Its Relationship to Diet Deficiency, Rinderpest, and Trypanosomiasis.]—*Clinica Vet.* 1920. Feb. 15. Vol. 43. No. 3. pp. 65–92. With 4 plates comprising 10 figs.

In this article Croveri describes an interesting neuro-muscular condition of cattle in Somaliland somewhat reminiscent of the chronic forms which are stated to occur sometimes in the South African cattle disease known as "lamziekte." Moreover, as transpired in the course of investigations into the nature of that disease, particularly as the outcome of HEDINGER's histological researches, sarcosporidia, which are found in great numbers in the muscles of affected animals, are here again incriminated. The article is indeed of value inasmuch as a most useful résumé of the literature dealing with sarcosporidial infestation in animals is given. Otherwise it certainly cannot be said that the author has proved his case that these protozoan parasites are directly accountable for the condition. Particular attention is paid to the investigations of HEDINGER in connection with lamziekte, and MCGOWAN in connexion with the Scottish disease of sheep known as scrapie; and, as is well known, it is now universally held that this author's contentions were unfounded.

The disease made its appearance among cattle belonging to the Serum Institute in 1914, but it was subsequently found that cases occurred among cattle in other parts of the colony. Cases first usually appeared towards the end of December, became more numerous towards February and March, and diminished in May at the approach of the first rains, when the pasture again began to grow luxuriantly. Cattle of all ages and both sexes were affected, and in particular the serum-producing animals of the Institute were attacked.

The mortality-rate was always very high (95 per cent). Recovered animals showed no immunity, but seemed to be even more susceptible to a fresh attack—ending fatally. The percentage of animals affected was particularly high when certain predisposing conditions, such as deficient diet, affected to an equal extent all animals in a herd. In the district of Lugh about 100 per cent. became affected. Among virus-producers at the Institute the proportion was about 30 per cent., while among serum-producers it was about 14 to 15 per cent. In the following year the fatalities on the other hand were very few, inasmuch as young animals had been well nourished.

The disease generally ran a chronic course, rarely subacute, and very rarely acute. In the chronic form the disease is insidious in its onset, and, as a rule, the first symptoms observed are those of some difficulty or impediment in movement. Attention is often first

attracted by the animals lagging behind the others in a herd, and it is usually found that such animals have lost their vivacity for some time in spite of unimpaired appetites. Otherwise, when grazing or when placed in their stalls, it is difficult to single out the affected animals from the others. When the herd is grazing on sandy soil the animals are often found to be addicted to eating sand, but this phenomenon is not observable in all animals. When carefully examined it is found that the lameness is accompanied by a marked rigidity of the muscular masses during movement. Otherwise no noteworthy symptoms are observable—the temperature, pulse, and respiration are normal, as also are the appetite, rumination and defaecation. The visible mucous membranes are pale in colour. In a more advanced stage loss of condition gradually sets in, whilst the muscular stiffness becomes accentuated, and before long the emaciation becomes most marked and the animals are no longer capable of following the others in a herd.

After a variable length of time, generally 7 to 20 days, and when the loss of condition has become marked, the animal is no longer capable of supporting itself on its feet. In the morning, thus, it may be found lying down quietly, perhaps ruminating, without showing the least signs of pain. If violently disturbed it does not get up, but if forcibly raised on to its feet it goes down again and the time it is capable of standing on its feet becomes progressively shorter as the disease advances. Usually this incapacity to stand is due to weakness in the hindquarters, for if disturbed the animal makes an effort to get up with its fore legs, but the hind legs refuse to respond. Nevertheless, the temperature, pulse, respiration and appetite still usually remain normal, and in many cases also rumination and defaecation function perfectly. In other cases rumination becomes partially suspended, and the animal becomes affected with constipation, followed by diarrhoea; but these symptoms are not characteristic.

At a more advanced stage paralysis extends to the fore quarters, and the animal lies down motionless extended on its flanks. If some forage is placed within reach the animal will attempt to seize it, as it is still capable of moving its head and tongue. Soon, however, the muscles of mastication and deglutition become paralysed and the animal becomes quite incapable of feeding. Thenceforward the emaciation, which may hitherto have not been very evident, becomes very striking, and the animal enters into a cachectic state before it eventually succumbs.

In a large majority of cases, and especially in calves, there become apparent, at the time when paralysis of the forequarters sets in, or sometimes before this phase, symptoms of muscular excitability affecting especially the neck muscles. The animal then presents an appearance exactly resembling that of tetanic opisthotonus. The superior cervical muscles are violently contracted, so that the head is carried backwards, the pupils are dilated, and thus the animal presents the characteristic expression of an animal affected with tetanus, and if the neck is straightened out forcibly it soon reverts to its former position. These symptoms of muscular excitability are never absent in the subacute form, but they may be absent in the chronic form, and they are more frequent in the calf than in the adult ox.

The time from when symptoms of muscular stiffness are first manifested up to the time of death varies from 25 to 50 to 60 days in the chronic type, but subacute or very rarely an acute type may be seen, the principal differences noticeable being the more rapid progress

of the symptoms. The period of observable muscular rigidity may be very short or may be altogether missed on account of its short duration. The first symptoms of the disease are, then, incapacity to remain standing, followed rapidly by signs of paralysis, affecting the hindquarters, forequarters, the muscles of deglutition and mastication, and phenomena of muscular excitability, which, in general, are never absent in this form. This type runs its course in from one to two weeks. In the very rarely occurring acute form symptoms are exhibited only for three or four days. The animal is generally found lying down, unable to get up, and a state of muscular excitability quickly sets in, whilst the temperature, pulse, and other organic functions remain normal. Death occurs on the third or fourth day, preceded by a fall in temperature.

The post-mortem lesions are very few and certainly not characteristic. There is very often oedema of the subcutaneous connective tissue, slight oedema of the lymphatic glands, the blood is anaemic and clots slowly, and there is often some straw-coloured exudate in the peritoneal cavity. There is usually more or less distinct congestion of the mucous membrane of the fourth stomach, and in the small intestines lesions are most frequently found, and these may vary in degree from the simple congestion up to ulceration of the mucous membrane, the gravity of the condition depending on the duration of the symptoms. When death occurs rapidly, the changes are often absent, whilst they are slight in subacute cases. The first part of the large intestine is usually in the same condition as the small intestine, but the last part of the colon and rectum are usually quite normal. The liver, spleen, kidneys, bladder and lungs show no noteworthy changes. In the heart, lesions are found affecting the endocardium in about 85 per cent. of cases, and these are in the form of petechiae, sometimes covered with deposit, especially in proximity to the valves. The myocardium is generally flabby. The pericardial sac usually contains a quantity of a clear, straw-coloured liquid, and in some cases it may be turbid, due to the presence of fibrinous flakes.

In nearly all cases there is a diffuse or circumscribed leptomeningitis. The brain matter shows no visible lesion. The nervous lesions are more marked in cases where symptoms of excitability have been displayed during life. Sometimes there is an increase in the amount of cerebro-spinal fluid. In the subacute form one finds only slight intestinal lesions, rarely cardiac lesions, and always meningitis; whilst in the acute form meningitis is the only lesion, and it is always found.

The author made a careful study of the blood. It contained no pathogenic trypanosomes, but in some cases non-pathogenic *T. theileri* was seen, and in almost all the animals *Theileria mutans* could be discovered. In all chronic cases there was a gradual diminution in the red and white corpuscles, which eventually dropped to about half the normal number.

Throughout the muscular system there were always discoverable extremely numerous sarcocysts of all dimensions. These were from 10 to 14μ long by 5 to 7μ broad. In the intestines no coccidia or other pathogenic protozoa were discoverable. Bacteria were isolated from some cases, especially those in which there were gross intestinal lesions, but the author was unable to reproduce the disease in healthy animals by inoculation of cultures, or by ingestion, or by administration per rectum.

Various kinds of intestinal worms were found, such as Trichocephalus, Oesophagostomum and Haemonchus, but these did not appear to be sufficiently numerous, or, indeed, of sufficient pathogenicity to be responsible for the disease. Nevertheless, experiments were made in an attempt to transmit the disease by ingestion of living worms or their ova or larvae in various stages of development, with constantly negative results.

Some attempts were made at treating the disease on the assumption that sarcosporidia were responsible for the condition, but that a deficient nutrition was a predisposing cause. It was found that when an animal had entered into the second period of the disease, that is to say, when marked symptoms of stiffness or paralysis had become evident, no change in the quantity or quality of the ration was capable of arresting the course of the disease. Attempts at treating symptoms with tonics, stimulants, or sedatives, etc., likewise proved fruitless. Prophylactic treatment, nevertheless, gave invariably good results. When the animals are first seen to lose condition gradually, they should, immediately on their return from pasture, be supplied with a plentiful and nutritious diet. Thus, when the animals used for serum production at the Serum Institute were given such a ration, cases of the disease immediately ceased, whilst numerous cases occurred in a herd of calves which were left purposely to look after themselves during the dry season; in fact, none of them escaped the disease.

The author concludes that in the first place the disease is not attributable to an infectious or parasitic intestinal invasion, but to a defect in nutrition, inasmuch as (1) the disease is manifested only among serum producers, which are submitted to a considerable drain upon their system, and not among the animals of the breeding station, which are given a sufficient ration; (2) the disease is manifested always during the dry season, during which there is a lack or deficiency of pasture; (3) the epizootiology and symptomatology of the disease is against the hypothesis of infectious or parasitic origin; (4) when the organization of the Institute enabled it to provide the serum producers with a supplementary ration, cases of the disease disappeared; and (5) the condition was set up artificially in a group of calves supplied with an insufficient diet.

The author further maintains that a diet deficiency is not sufficient to account for the muscular and nervous phenomena. In all animals dead of the disease sarcosporidia were found in enormous numbers throughout the muscular system, and it is therefore suggested that all these symptoms are possibly due to the presence of these parasites. The author examined for sarcosporidia the muscles of the tongue, pharynx, oesophagus, shoulder, buttocks and thighs, heart, etc., and found sarcosporidia in 69 (85 per cent.). In these 69 animals parasites were found in the oesophagus, tongue and cardiac muscle only in 59, and these 59 animals were in good condition. Of the 10 animals which also showed the parasites in their striped muscle, four which showed rare parasites were in good condition, whilst four which showed rather few were in poor condition, and two, in which they were very numerous, were in extremely poor condition.

The author therefore concludes that in the majority of Somaliland cattle, probably 85 per cent., and possibly in all animals if a more careful examination were made, sarcosporidia are to be found in the muscular system. But generally these parasites are limited to the smooth muscles of the oesophagus and of the tongue and to the heart muscle. Their abundance in the muscle would appear to be closely

related to the state of nutrition of the animal. The author therefore emits the view that when the animal is in good condition the parasites are not capable of traversing the barrier formed by the first part of the digestive tract, but when it is in low condition they invade the whole body. [This does not appear to be true. See VILJOEN, 1920, Vol. 8, p. 302, and WALKER, p. 301.] In sucking calves sarcosporidia were not seen, and it would appear that the infection is contracted at pasture. This would contra-indicate MCGOWAN'S hypothesis that the sarcosporidiosis may be transmitted hereditarily. In calves at pasture the percentage invaded is almost identical with that in larger animals. In healthy calves kept in good condition the parasites were found to be limited to the oesophageal and heart muscles, as in adults; but in calves affected with rinderpest the striped muscles were also found to have become invaded, and in one calf slaughtered on the seventh day of the disease, spores were found in the circulating blood. From observations on calves affected with rinderpest at the Institute, the author concluded that during the course of the rinderpest infection the sarcosporidia depart from the seats normally affected, that is to say, the oesophagus, heart, etc., and invade the whole muscle system. In a considerable percentage (40 per cent.) of animals recovered from the disease a generalized invasion of the muscular system by the parasites was set up, and this produced a fatal form of the disease described in this paper. The animals which become affected with sarcosporidiosis are usually those in which rinderpest has produced the most grave effects. Likewise the author believes that in animals recovering from trypanosomiasis, sarcosporidial infestation may supervene.

[The author's description of this condition is of much interest and has been given quite fully above, for it appears to resemble other conditions found in tropical and sub-tropical countries, particularly the lamziekte of cattle in South Africa, and certain sheep diseases, notably "renguera" in South America, characterized mainly or merely by the presence of marked neuro-muscular symptoms without noteworthy lesions. Lately, the pathology of the South African cattle disease appears to have been very fully worked out. It would appear to be due to the effects of a toxin absorbed from the alimentary tract, and this toxin is elaborated by certain species of anaerobes found in the soil of certain localities. It would seem that this organism is ingested by the animals licking putrefying carcases which are allowed to lie about on the veldt in such districts; the depraved appetite which causes the animals to lick such material would be induced by a deficiency in diet. The particular ingredient deficient in the food appeared to be phosphorus, and by supplying mineral matter, such as bone ash, containing this element, the craving could be made to disappear and likewise the lamziekte. (See this *Bulletin*, 1920, Vol. 8, p. 261.) It would be interesting to find out whether the same factors are responsible in the Somaliland condition. The symptomatology of the two affections certainly presents striking analogies.—J. T. E.]

CÉSARI (M.). **Un procédé commode de recherche des sarcosporidies dans les muscles.** [A Convenient Method of Searching for Sarcosporidia in Muscle.]—*Rec. Méd. Vét.* 1921. Feb. 28. Vol. 97. No. 4. pp. 100–102.*

The usual method of searching for sarcosporidia in muscle tissue consists in making a microscopic examination either of cut sections

* Abstracted by Mr. T. J. Bosworth, B.Sc., D.V.S.M., M.R.C.V.S.

or of small fragments that have been crushed between two slides. Whilst carrying out some investigations on the manufacture of sausages, Césari discovered by microscopic examination that the fluid which exudes from salted flesh often contains falciform corpuscles that are characteristic of sarcosporidia. It appeared to him that here was a simple and very convenient method of detecting sarcosporidia, and one that would reveal their presence even where invasion was so slight that it might be overlooked under ordinary conditions unless a very large number of preparations were made. He has not had an opportunity of testing its efficacy in the case of muscle containing calcified parasites, but its failure under these conditions would not be of great importance since such lesions are easily visible to the naked eye.

In carrying out the method it is sufficient to take a fairly large piece of muscle, sprinkle it all over with salt, and place it in a receptacle, preferably a funnel suspended over a flask. In a few minutes a reddish serosity exudes from the flesh and collects in the vessel. A drop of this fluid is taken and examined between slide and cover glass under a magnification of 800 diameters. The characteristic corpuscles are seen as elongated elements, slightly crescentic in shape, with rounded ends. They have granular contents and show refractile points. Their length is about three times the diameter of a red blood cell. The numbers seen in such a preparation are proportional to the invasion of the muscle. This method may also be adopted with advantage for the preparation of the specific poison of muscle sarcosporidia (sarcocystine). All that is necessary is to centrifuge the serous fluid, thus obtaining a deposit of red blood corpuscles and sarcosporidia. By haemolysing the red blood cells and again centrifuging, a nearly pure deposit of sarcosporidia may be obtained. It remains to be determined whether the sarcosporidia which appear in the fluid are elements which were lying free in the capillaries of the muscle or the interfibrillar spaces, or whether they were actually contained within the utricles themselves.

DISEASES DUE TO METAZOAN PARASITES.

RILEY (William A.). **A Provisional Key to the Adult Nematode Parasites of Equines.**—*Cornell Veterinarian.* 1921. Jan. Vol. 11. No. 1. pp. 21–41. With 36 text figs.*

"In spite of the interest in the study of the parasites of the horse and other equines which has been aroused during recent years, there is no comprehensive key by which the student may determine even roughly the specimens which come to his attention.

"The average 'determination' is made by running through a list of parasites of the host and selecting the name of the species found in the given organ and most nearly agreeing with the body measurements of the specimen in hand. Or, at best, the specimen is compared

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with the illustrations in some available text book and, with a comfortable disregard of the numbers of unlisted species, is duly labelled.

" It is in the hopes of affording some assistance to the isolated worker, who has not access to the extensive literature of the subject, that the following key to the nematode parasites of equines is offered. It is avowedly provisional and subject to corrections, but nevertheless it is thought that by its use the great majority of adult nematodes of these animals may be located. It must be recognized that it is purely an artificial key and textual proximity of species in nowise necessarily indicates relationship.

" Moreover, especial attention should be called to the forms of intestinal strongylids now included under *Cylicostomum* (= *Cylichnostomum*). Under this genus there have been described up to date 23 species of equine parasites (including two from the zebra). Of these, 16 indicated in the key by (*) have been reported from North America, but there is no question but that a number of our species are as yet undescribed. The genus demands thorough-going study. It seems very probable that the species now included in it represent two or more genera.

" The characters which must be used in classifying parasitic nematodes cannot be seen with the hand lens but demand the use of the compound microscope or high powers of the binocular, and especially treated specimens. Whenever possible the worms should be killed in hot 70 per cent. alcohol. If they are to be mounted as permanent objects, there should be added to the alcohol 3–5 per cent. of glycerine and the bottle left loosely stoppered or plugged with cotton until the alcohol has evaporated and the worms left in pure glycerine. They should then be mounted in glycerine jelly.

" For temporary study of alcoholic specimens or specimens preserved in alcohol-glycerine, they should be removed to the carbol-alcohol mixture (carbolic acid 1 part, and absolute alcohol 4 parts) in which they promptly clear and show beautifully the details of structure. Before returning such specimens to alcohol glycerine, the carbolic acid should be well washed out in 70 per cent. alcohol, else they blacken. Boulenger, 1920, recommends ' pure white creosote into which the worms may be transferred direct from alcohol without shrinkage.'

" The illustrations accompanying the text have in most cases been adapted from the original figures, care being taken to represent correctly the salient distinguishing characters. On account of the great rarity and inaccessibility of Looss's fundamental monograph on the strongyles of the horse, most of his figures dealing with species reported from North America have been utilized, excepting, as a rule, those which have already been made available by Ransom and Hadwen, 1918.

" The form of key used has been adopted for the purpose of conserving space. For those who are unaccustomed to this form, it may be explained that the number in brackets following each number is the alternative. If, for example, the specimen does not show the characters listed under ' 1 ' turn to ' 30 ' in the key.

" The writer wishes to express his indebtedness to Dr. C. P. Fitch and Dr. D. C. Beaver of the Veterinary Division of the University of Minnesota, for opportunities and generous aid in securing specimens.

"*Key to the Adult Nematode Parasites of Equines.*

"1 (30) Mouth cavity not enlarged to form a buccal capsule. Males without a well-developed caudal bursa supported by a system of paired rays. (The genera *Trichostrongylus* and *Dictyocaulus* have feebly developed mouth cavities but males possess the bursa, hence see 30).

"2 (5) Relatively thick worms. Mouth with three lips, of which the largest is dorsal, the other two ventral in position. ASCARIDAE.

1

Ascaris equorum.
Dorsal view.

"3 (4) Male with two spicules and numerous pre- and post-anal papillae. Female with caudal end conical. Ova globular or ellipsoid. Oesophagus with simple flask-shaped swelling. *Ascaris*, Linnaeus, 1758.

One species, *Ascaris equorum*, Goeze, 1782 (*A. megalocephala*, Cloquet, 1824), in small intestine of horse, ass and mule. Male 150–250 mm., female 180–370 mm.

"4 (3) Male with one spicule and two pairs of pre-anal papillae. Female with caudal end elongated and subulate; eggs elongate, asymmetrical, with one side flattened. Oesophagus with a rounded bulb or a swelling at distal end. *Oxyuris*, Rudolphi, 1803.

2

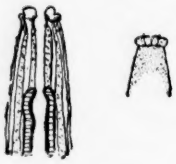
O. equi.

Oxyuris equi (Schrank, 1788) (= *O. curvula*, Rudolphi, 1803) is found in the large intestine of Equidae. The female is 40–150 mm. long, arched at its anterior extremity and rapidly narrowed posteriorly into a tail varying greatly in length in different individuals. The males, which are very rarely collected, measure 9–12 mm. in length. Individuals with very long tails have been distinguished by some authors as *Oxyuris mastigodes* but most authorities regard them as of one species.

"5 (2) Relatively more slender species.

"6 (7) Minute females not exceeding 2·5 mm. in length ; mouth provided with six lips ; posterior end terminating in a very slender tail ; pear-shaped oesophageal bulb ; vulva near middle of body ; no bursa ; two spicules approximately equal.

Probstmayria vivipara
(Probstmayer, 1865), Ransom, 1907



3b 3a

P. vivipara.
(*a*) Dorsal view of anterior end of body. After Ransom.
(*b*) Optical horizontal section through anterior end of body. After Ransom.

"7 (6) Body long and filiform ; oesophagus slender and without bulb. Males with caudal end coiled, and with two unequal spicules ; one very long and one much shorter. Females with double ovary, vulva in most cases at anterior end of body. FILARIDAE.

"8 (15) With striking and characteristic cuticular markings.

"9 (10) Cuticular markings in the form of four thickened longitudinal cords at the anterior end. Males with lateral wings at the caudal end ; females with simple ovary ; oviparous.

Dispharagus, Dujardin, 1845.

One species, *D. reticulatus*, has been found in tumors in the pharynx of the horse.

3[1]

D. uncinatus.
After Schneider.

"10 (9) Cuticular markings not in the form of four longitudinal cords.

4

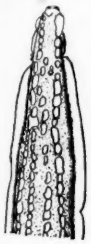
Onchocerca cervicalis. Fragment of body, showing cuticular markings. After Railliet.

" 11 (14) Cuticle thick, cross striated and marked externally by spiroid thickenings. Male always with four pre-anal papillae ; longer spicule terminating in a point, the shorter clavate, with a lateral retrograde hook. Female very long, vulva near head ; viviparous. Inhabiting the connective tissue. *Onchocerca*, Diesing, 1841.

" 12 (13) Males up to 270 mm. long by 0·15 mm. ; posterior extremity flattened and curved ; six papillae on one side and seven on the other. Female 560 mm. in length by 0·25 mm. in diameter. Found especially in the suspensory ligament of the fetlock and the flexor tendons of the feet. *O. reticulata*, Diesing, 1841.

" 13 (12) Male 175–300 mm., female up to 400 mm., vulva situated about 400 μ from the mouth. In cervical ligament. *O. cervicalis*, Railliet and Henry, 1910.

" 14 (11) Anterior portion of the body covered with numerous cuticular tubercles, or shields, vulva of female in posterior end of body, near arms. *Gongylonema*, Molin, 1857.



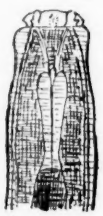
5
G. scutatum.
Dorsal view. After Neuman.

Gongylonema scutatum (Mueller, 1869), Railliet, 1892, is found in the lining epithelium of the oesophagus of the horse, as well as of cattle and sheep.

" 15 (8) Without striking cuticular markings.

" 16 (21) Mouth followed by an infundibuliform pharynx which resembles a buccal capsule. Vulva of female more than a third of the length from the mouth. Tail of the male spirally coiled and with membranous wings. Relatively short and thick. *Habronema*, Diesing, 1861.

" 17 (18) Mouth with four thick chitinous lips which project in such a way as to present the appearance of a head constricted off from the remainder of the body. Males 7–10 mm. long ; females 10–13 mm. In tumors in the stomach of the horse and ass. *H. megastoma* (Rudolphi, 1819).



6
H. megastoma.
After Railliet.

" 18 (17) Without the constriction at the cephalic end. Larger species.

" 19 (20) Pharynx broad, its greatest diameter half the breadth of the body at the same level. A tridentate process projecting into the mouth from the dorsal wall of the anterior part of the pharynx and a similar one present on the ventral wall. Longer spicule of male 800 μ; the shorter one 350 μ. Vulva slightly over a third of the body length from the anterior end, rather large (diam. 30 μ) and approximately mid-ventral in position; vagina with a distal S-shaped curve. Males 9–16 mm. in length; females 15–25 mm.
Habronema microstoma (Schneider, 1886).

7
H. microstoma.
Anterior end of adult.
After Ransom.

" 20 (19) Pharynx narrow, its greatest diameter less than one-fourth the breadth of the body at the same level; pharynx without tooth-like processes. Longer spicule of male about 2·5 mm., the shorter one 500 μ. Vulva about a third of the body from the anterior end, very small and displaced dorsad; vagina without the distal S-shaped curve. Males 8–14 mm., females 13–22 mm., thus averaging smaller than in the above species.
Habronema muscae (Carter, 1861).

8
H. muscae.
Anterior end of adult.
After Ransom.

" 21 (16) Without infundibuliform pharynx. Vulva of female in anterior third of body, usually near the mouth.

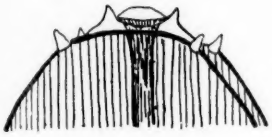
" 22 (23) Lips lacking; buccal capsule relatively small, oesophagus short. Males 8–12 mm. long, females 14–18 mm. long. Vulva posterior to end of oesophagus, parasitic in the eye. *Thelazia lacrymalis*, Gwilt, 1831.

" 23 (22) Lips present or absent, but not presenting the above characters; body long and filiform, of uniform diameter. Vulva usually opens near the mouth.

" 24 (25) Vulva lacking in gravid female, which is 50–80 cm. in length, and lives as a subcutaneous parasite.
Dracunculus medinensis, Linnaeus, 1767.

" 25 (24) Vulva present in gravid female.

" 26 (27) Mouth armature of a projecting peribuccal ring considerably constricted laterally, less so dorsally and ventrally; a medium papilla both dorsally and ventrally. A little caudad of the mouth are two pairs of submedian spines. Males 6–8 cm. in length; females 9–12 cm.; in the peritoneal cavity, more rarely in the pleural sack, and other serosa, or in the eye.
Setaria equina (Abildgaard, 1789).

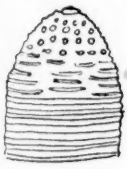


9

S. equina. Lateral view of anterior end. After Railliet.

" 27 (26) Not as above.

" 28 (29, 30) Anterior end with cuticular striae becoming irregular and forming elongate thickenings grading into elliptical and finally circular pattern; mouth naked and circular. Males 28 mm., females 40–56 mm. or even 70 mm., living together in the subcutaneous and intermuscular connective tissue.
Filaria haemorrhagica, Railliet, 1885.



10

F. haemorrhagica. Anterior end. Railliet after Condamine.

" 29 (28) Mouth without lips but with six nodular papillae; oesophagus very long without swelling; anus terminal in the female, vulva in the interior half of the body. Male with a terminal, oval bursa, which is not lobed; a single very long spicule. The largest of known parasitic nematodes; males 14–40 cm., females 20 cm. to 1 meter in length. In kidneys or body cavity.
Dioctophyme renale (Goeze, 1782).

11

D. renale. After Riley and Chandler.

" 30 (1) Body elongate, cylindrical, rarely filiform, well developed buccal cavity (except in *Trichostrongylus* and *Dictyocaulus*); mouth naked or with a chitinous armature; males generally with two equal or subequal spicules, and with well developed caudal bursa supported by a system of six rays. Vulva usually behind the middle of the body. STRONGYLIDAE.

" 31 (36) Mouth cavity very small, buccal capsule absent or feebly developed.

" 32 (33) Mouth provided with three little lips and with papillae. Caudal bursa with lateral lobes; spicules in the form of spatulae. Vulva situated in the posterior part of body. Males 3–8 mm., females 5 mm., in mucosa of stomach. *Trichostrongylus axei* (Cobbold, 1879).

" 33 (32) Mouth circular and naked.

" 34 (35) Caudal bursa small, not lobed ; middle rays simple, posterior tridentated ; spicules small, acute. Tail of female short and sharp ; vulva near middle of body. Eggs 85 by 35 μ. Males 40 mm., females 60–80 mm., found in the bronchi.

Dictyocaulus viviparus (Bloch, 1782).

" 35 (34) Caudal bursa short, faintly lobed, middle rays bifed, posterior thick, bilobate, and widely united at base. Tail of female short, slightly curving, terminating in a blunt point. Eggs 80 to 100 μ long by 50 to 60 μ wide. Males 28–36 mm., females 45–55 mm.

Dictyocaulus arnfieldi (Cobbold, 1884).

12

D. arnfieldi. Caudal bursa. Gedoelst, after Railliet.

" 36 (31) Mouth cavity enlarged to form a well developed buccal capsule, often armed with teeth in its interior.

STRONGYLINAE.

" 37 (40) Head separated from the body by a constriction. Buccal capsule consisting of an extra-oesophageal part and an intra-oesophageal portion formed by the chitinisation of the oesophageal funnel. Posterior to this dilation the oesophagus is very narrow, while immediately beyond the nerve ring it enlarges, thus giving the whole oesophagus the appearance of an Indian club, whose handle is the anterior end.

Gyalocephalus, Looss, 1900.

13

G. capitatus. Head, ventral view. After Yorke and Macfie.

" 38 (39) Genital cone of male extending as far as the free margin of the lateral lobes of the bursa.

**Gyalocephalus capitatus*, Looss, 1900.

14

G. capitatus. Posterior extremity of male, lateral view. After Yorke and Macfie.

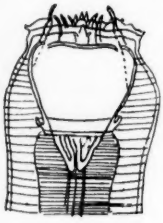
" 39 (38) Genital cone of male protruding far beyond the bursa, being about twice as long as in *capitatus*.
**Gyalocephalus equi*, Yorke & Macfie, 1918.

15

G. equi. Posterior extremity of male, lateral view. After Yorke and Macfie.

" 40 (37) Head not separated from the body by a pronounced constriction ; oesophagus not shaped like an Indian club.

" 41 (42) Oesophageal funnel well developed and with three teeth ; no teeth in or projecting into the buccal cavity.
Oesophagodontus, Railliet & Henry, 1902.



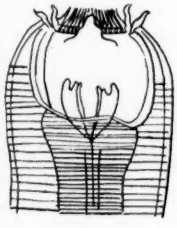
16

O. robustus.
After Boulenger.

* *O. robustus* (Giles, 1892) is found in the colon and caecum of the horse and ass. Body robust, tapering only slightly towards anterior end ; males 15–16 mm., females 19–22 mm. in length ; eggs from uterus 100–130 μ by 50–60 μ.

" 42 (41) Oesophageal lining not modified to form tooth-like structures.

" 43 (52) With three denticulate and often serrate teeth projecting into the buccal capsule from the oesophageal funnel. Borders of the caudal bursa denticulate.
Triodontophorus, Looss, 1902.



17

T. brevicauda.
After Boulenger.

" 44 (47) Teeth denticulate but not serrate. Dorsal lobe of bursa long ; spicules slender.

" 45 (46) Male 13·5–14 mm., female 16–17 mm., mouth collar erect, elements of leaf crown 60. Vulva about 0·3 mm. from posterior end, immediately in front of anus.
**Triodontophorus brevicauda*, Boulenger, 1916.

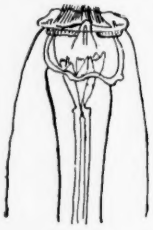
" 46 (45) Male 13 mm., female 14 mm., mouth collar depressed at margin ; elements of leaf crown 44–49. Vulva about 0·7 mm. from posterior end.
Triodontophorus minor, Looss, 1902.

" 47 (44) Teeth denticulate and serrate. Dorsal lobe of bursa short ; spicules comparatively thick and upwards of 4 mm. in length, except in *T. tenuicollis*, where they are slender and 1·25 mm. long.

" 48 (49) Vulva very close, ca. 0·5 mm. from posterior end. Dorsal lobe of bursa short and sharply marked off from lateral lobes. Dermal collar of genital cone completely surrounds cone. Spicules slender, 1·25 mm. long. Female 16–19·5 mm., male 13·5–19 mm.
**T. tenuicollis*, Boulenger, 1918.

" 49 (48) Vulva 1·5 to over 2 mm. from posterior end. Dermal collar of genital cone covers anterior surface. Spicules thick, 3·5–4 mm. long.

" 50 (51) Male 18 mm., female 25 mm., mouth collar slightly depressed at margin ; elements of leaf crown 52–55. Vulva more than 2 mm. from posterior end. Spicules 4 mm. long.
**T. serratus*, Looss, 1902.



18
T. serratus.
Ransom and Hadwen, after Looss (modified).

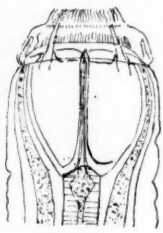
" 51 (50) Males 14·5–15·5 mm., females 16·5–18·7 mm., mouth collar circular in outline ; elements of leaf crown 48. Vulva 1·45–1·7 mm. from posterior end. Spicules 3·5 mm. long. **T. intermedius*, Sweet, 1909.

" 52 (43) Teeth present or absent but not of the type above described.

" 53 (60) Buccal capsule very large, hemispherical or oval, with its dorsal wall strengthened by a longitudinal gutter which bifurcates at the base. No cervical papillae present. *Strongylus*, Mueller, 1784.

" 54 (55) No teeth at base of buccal capsule ; oesophagus enlarged, club-shaped posteriorly. Male 23–26 mm., female 33–36 mm.

**Strongylus edentatus*, Looss, 1900.



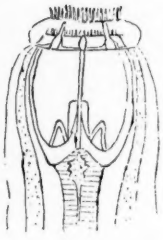
19

S. edentatus. Dorsal aspect. After Looss.

" 55 (54) Teeth present at base of buccal capsule.

" 56 (57) Four teeth, the dorsal high and slender, closely apposed with only basal ends diverging ; the other two triangular in optical section. Oesophagus only slightly swollen. Male 35 mm., female 45–47 mm.

**Strongylus equinus*, Mueller, 1784.



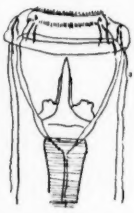
20

S. equinus. Head of male, dorsal view. After Looss.

" 57 (56) Apparently two rounded teeth at base of capsule (in reality lobes of a single tooth).

" 58 (59) Dorsal gutter not reaching anterior margin of mouth capsule ; lobes of tooth broad as high in dorsal view, their margins cusped. Males 18–32 mm., females 30–42 mm.

Strongylus asini, Boulenger, 1920.

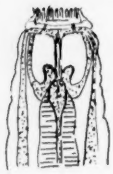


21

S. asini. After Boulenger.

" 59 (58) Dorsal gutter reaching anterior margin of mouth capsule, lobes of tooth higher than broad in dorsal view, margins smooth, rounded. Males 14–16 mm., females 23–24 mm.

**Strongylus vulgaris* (Looss, 1900).



22
S. vulgaris.
After Looss.

" 60 (53) Buccal capsule smaller, more cylindrical; longitudinal gutter present or absent. A pair of cervical papillae just posterior to the nerve ring, near base of oesophagus.

Cylicostomum, Railliet & Henry, 1902.

" 61 (79) Caudal end of female bent dorsad. Head capsule without dorsal longitudinal gutter (except in *C. nassatum* and its variety *parvum*).*

" 62 (63) Dorsal gutter of oesophagus projects well into the head capsule. Walls of head capsule straight and slender, with a well marked hoop-like thickening posteriorly; ratio of breadth of anterior opening to depth 2·7 : 1, external leaf crown of 20 usually projecting elements. Tail bent only slightly dorsally. Males 10 mm., females 14 mm. in length.

**Cylicostomum nassatum* (Looss, 1900).

Males 7 mm., females 8·8

* variety *parvum*, Yorke & Macfie, 1918.

" 63 (62) Dorsal gutter not projecting into the head capsule.

" 64 Caudal end of female abruptly narrowed and bent dorsad at a greater or less angle.

* The dorsal bend of the tail in the females of *C. nassatum* and *C. nassatum parvum* is so slight that these forms may also be keyed under the alternative heading.

" 65 (72) Buccal capsule with walls thicker in the middle.

" 66 (69) Tail of female bent dorsad at an obtuse angle to body. Dorsal lobe of bursa of male elongate.

" 67 (68) Spicules very long and hair-like, genital cone enormously developed. Buccal capsule broad, ratio of breadth to depth 5 to 2. Males 12 mm. long, females 14 mm.

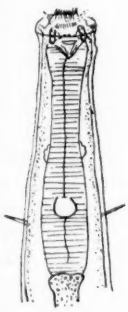
Cylicostomum mattami (Leiper, 1913).

" 68 (67) Spicules and genital cone not strikingly long. Buccal capsule relatively narrower; external leaf crown of 29 short, pointed, scarcely projecting elements. Males 10 mm., females 12 mm.

Cylicostomum alveatum (Looss, 1900).

" 69 (66) Tail of female directed dorsad at right angle to body. Dorsal lobe of bursa of male short and broad, almost hemispherical.

" 70 (71) Body small and rather delicate, male 5·2–6 mm., female 6–6·7 mm., with maximum breadth 0·3 mm. Dermal collar surrounding the genital cone; appendages of genital cone characteristic thin delicate plates, each provided with two very slender finger-like processes. **Cylicostomum goldi* (Boulenger, 1917).



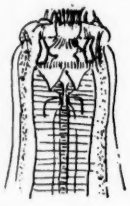
23a

23b

C. goldi. (*a*) Anterior end; (*b*) ventral view of genital cone of male. After Boulenger.

" 71 (70) More robust species, male 7–8 mm., female 9 mm., with maximum thickness 350 μ. Caudal end of female with ventral prominences large and projecting. Appendages of genital cone of male not as above.

**Cylicostomum catinatum* (Looss, 1900).



24a

24b

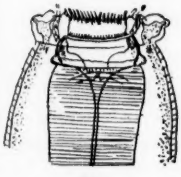
C. catinatum. (*a*) Anterior end; (*b*) Ventral view of genital cone of male. After Boulenger.

" 72 (65) Buccal capsule with walls with a ring-like thickening at the base.

" 73 (76) Tail of female bent dorsad at an obtuse angle.

" 74 (75) Dorsal lobe of bursa of male broad; dermal collar of genital cone well developed; its appendages broad and fused mesally, each bearing a little papilla-like process. External leaf crown of about 36 large pointed leaves. Males 11–12 mm., females 13·5–15 mm.

**Cylicostomum insigne* (Boulenger, 1917).



25

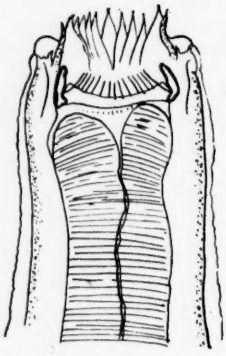
C. insigne. After Boulenger.

" 75 (74) Dorsal lobe of bursa narrow. External leaf crown of 26 rather flat elements. Males 11 mm., females 13–14 mm. **Cylicostomum radiatum* (Looss, 1900).

" 76 (73) Tail of female bent dorsad at right angles. Dorsal lobe of bursa short and broad.

" 77 (78) Walls of buccal capsule wedge-shaped, slender anteriorly, stout posteriorly, inner surface deeply notched ; ratio of breadth of capsule to depth 3·25 : 1. Ratio of posterior ray of bursa to body length of male 1 : 19·5 ; genital appendages slight elevations with three conical processes, of which the inner is the largest and has long delicate finger-like processes. Average distance between anus and vulva, 104 μ. Average length of males 8·6 mm., females 9·5 mm.

**Cylicostomum pateratum*, Yorke & Macfie, 1919.



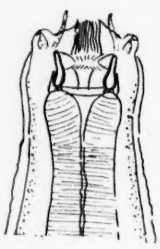
26a

26b

C. pateratum. (*a*) Anterior extremity, ventral view ; (*b*) Genital appendages, ventral view. After Yorke and Macfie.

" 78 (77) Walls of buccal capsule slightly kneed ; ratio of breadth to depth 1·5 : 1. Ratio of length of posterior ray of bursa to total length of male 1 : 22·4 ; genital appendages slight elevations, with two conical processes. Average distance between anus and vulva 61 μ. Average length males 5·8 mm., females 6·7 mm.

**Cylicostomum pseudocatinatum*, Yorke & Macfie, 1919.



27

28

C. pseudo-catinatum.

Anterior extremity, ventral view.

Posterior extremity of male, lateral view. After Yorke and Macfie.

" 79 (61) Caudal end of female practically straight, or slightly reflexed.

" 80 (92) Dorsal gutter not present in buccal capsule.

" 81 (84) Walls of buccal capsule kneed, or constricted at middle ; dorsal gutter represented by a blunt tubercle at floor of mouth capsule. Dorsal lobe of bursa long to very long.

" 82 (83) Walls of buccal capsule thick, kneed. Dorsal lobe of bursa strikingly elongate and narrow, sides parallel. Ventral prominences at caudal end of female slight. Males 7–8 mm., females 9–10 mm.

**Cylicostomum coronatum* (Looss, 1900).

" 83 (82) Walls of buccal capsule constricted in the middle, dorsal gutter represented by a blunt tubercle at floor of mouth capsule. Dorsal lobe of bursa moderately long. Tail of female short. Males 9 mm., females 10–12 mm.
Cylicostomum tetracanthum (Mehlis, 1803).

" 84 (81) Walls of buccal capsule thick or with a ring-like thickening at the base or near the middle.

" 85 (86 & 91) Walls of buccal capsule short, thick throughout. Dorsal lobe of bursa short; appendages of genital cone without projecting points; pear-shaped, their thinner extremities diverging laterally. Ventral prominences at caudal end of female project only slightly. Males 7–8 mm., females 9–9·5 mm.
**Cylicostomum labratum* (Looss, 1900).

29

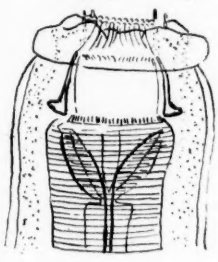
C. labratum. Genital cone, ventral. After Looss.

" 86 (85 & 91) Ring-like thickening at base of buccal walls.

" 87 (88) Buccal capsule very short, with ring-like thickening at the base. Dorsal lobe of bursa very short and broad. Tail of female very short, knob-like. Largest described species of the genus, males measuring 16–17 mm., females 26 mm.
Cylicostomum auriculatum (Looss, 1900).

" 88 (87) Buccal capsule large and deep, with ring-like thickening at the base. Dorsal lobe of bursa long, smaller forms.

" 89 (90) Oesophagus elongated, attaining 1·4 mm. in large females; external leaf crown of about 36 elements, whose rounded apices are usually curved outward. Dorsal lobe of bursa somewhat narrow and elongated; appendages of the genital cone strongly granular, completely opaque, allantoid, the rounded extremities bent inwards; no posterior point. Extremity of female gradually tapering to the anus, then suddenly narrowing into the short, stout tail. Males 13 mm., females 17 mm.
**Cylicostomum elongatum*, Looss, 1900.



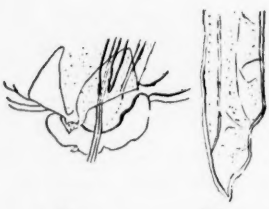
30a

30b

C. elongatum. (*a*) Anterior end; (*b*) Genital cone. After Looss.

" 90 (89) Oesophagus shorter, 0·9 mm. in female; external leaf crown of 26 rather flat elements converging horizontally towards the axis. Dorsal lobe of bursa much narrower and elongate, appendages of the genital cone not strongly granular; more elongate and with a short blunt point on the posterior surface. Extremity of female more abruptly tapering to the anus. Males 11 mm., females 13–14 mm.

**Cylicostomum radiatum* (Looss, 1900).



31a 31b

C. radiatum. (*a*) Genital cone of male; (*b*) Posterior extremity of female. After Looss.

" 91 (85 & 86) Wall of buccal capsule thickest near the middle, thinning towards each end. Dorsal lobe of bursa moderate; genital cone relatively enormous (310–400 μ); dermal collar greatly developed on its ventral face, and pre-bursal papillae very elongate; appendages of cone long, narrow and cirrus shaped. Males 6–7·2 mm. females 6–8 mm.

Cylicostomum euproctus, Boulenger, 1917.

" 92 (80) Dorsal gutter present, though sometimes short and inconspicuous.

" 93 (96) Dorsal gutter long and well developed.

" 94 (95) Species of moderate size. Dorsal lobe of bursa strikingly elongate with sides parallel. Tail of female slender and spine-like. Males 6–6·5 mm., females 8 mm.

**Cylicostomum calicatum*, Looss, 1900.

32

C. calicatum. Caudal bursa. After Looss.

" 95 (94) Species small. Dorsal lobe of bursa short, less than a semicircle; ratio of posterior ray to total length of body 1 : 26. Males average 4·3 mm., females 4·9 mm.

Cylicostomum minutum, Yorke & Macfie, 1918.

" 96 (93) Dorsal gutter short or very short.

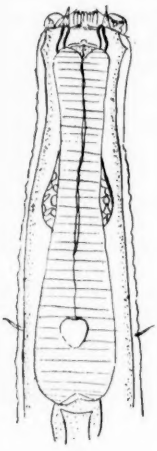
" 97 (98) Walls of buccal capsule kneed; breadth of capsule equals its length; dorsal gutter short. Dorsal lobe of bursa very long and narrow. Tail of female distinctly demarcated, straight, fairly long and tapers gradually to a point. Males average 5·1 mm., females the same.

**Cylicostomum longibursatum*, Yorke & Macfie, 1918.

" 98 (97) Walls of buccal capsule not kneed.

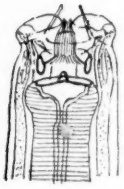
" 99 (100) Buccal capsule very short; its walls thickest in the middle; dorsal gutter a blunt tubercle. Dorsal lobe of bursa extremely short; appendages of genital cone absent. Pointed tail of female reflexed. Males 8·5–9 mm., females 10–11 mm.

**Cylicostomum labiatum* (Looss, 1902).



33

C. longibursatum. Anterior extremity, ventral view. After Yorke and Macfie.



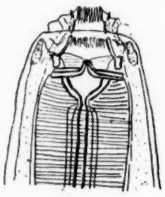
34

C. labiatum. Anterior portion, dorsal aspect. After Looss.

" 100 (99) Buccal capsule not exceptionally short; its wall thickest at base.

" 101 (102) Walls of buccal capsule very thick in basal half, abruptly thinning near apex; dorsal gutter prominent. Dorsal lobe of bursa strikingly elongate; appendages of the genital cone long and slender, with rounded extremities. Tail of female very short and conical. Males 12 mm., females 13–14 mm.

**Cylicostomum bicornatum*, Looss, 1900.



35

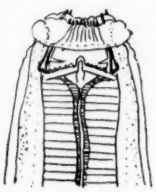
C. bicornatum. After Looss.

" 102 (101) Walls of buccal capsule not abruptly thinning. Dorsal lobe of bursa short, or only moderately elongate.

" 103 (104) Walls of buccal capsule straight and slender with a well-marked hoop-like thickening posteriorly; external leaf crown of 20 elements; oesophagus 0·4–0·6 mm. in length. Dorsal lobe of bursa elongate. Tail of female bent slightly dorsally. Males 10 mm., females 14 mm. in length.

**Cylicostomum nassatum* (Looss, 1900). Males 7 mm., females 8·8

*variety *parvum*, Yorke & Macfie, 1918.



36

C. nassatum. Anterior portion dorsal aspect. After Looss.

" 104 (103) Buccal capsule weakly funnel-shaped; external leaf crown of 35 elongated slender and pointed elements; oesophagus remarkably long (0·8 mm.). Dorsal lobe of bursa short. Tail of female straight, relatively long and strong. Males 8 mm., females 10 mm.
**Cylicostomum poculatum* (Looss, 1900).

" Since the key was in type there have come to hand descriptions of two new species of Cylicostomum by Ihle, 1920 (*Centrabl. f. Bakt.* etc., I Abt. Orig. vol. 84, p. 132–134, 562–565). *C. mucronatum* is closely related to *C. poculatum*. *C. brevicapsulatum* is characterized by having a mouth capsule extraordinarily thick, caudal end of female straight, bursa of male broad. *C. nanum*, Ihle 1920 = *C. longibursatum*, Yorke & Macfie."†

Brocq-Rousseu & Cauchemez. **Action du thymol sur les parasites intestinaux du cheval.** [The Action of Thymol on the Intestinal Parasites of the Horse.]—*Rec. Méd. Vét.* 1921. June 30. Vol. 97. No. 12 pp. 281–286.‡

The experiments here recorded were carried out in order to determine the effect of thymol on the various worms found in the intestinal tract of the horse. The worms were obtained direct from the slaughter-house and placed with as little delay as possible in solutions of thymol of varying strengths. Other worms were placed in normal saline solution to act as controls. The solutions were kept at a temperature of 37° C. The strengths of the thymol solutions were as follows :—A. 0·769 per 1,000 (saturated solution). B. 0·50 per 1,000. C. 0·25 per 1,000. D. 0·125 per 1,000.

The following table shows the length of exposure to each of the four solutions that is necessary to cause the death of the various parasites :—

	Solution A.	Solution B.	Solution C.	Solution D.
Ascarides	1¼ to 1¾ hrs.	2 to 3¾ hrs.	5¾ to 22 hrs.	7¼ to 22 hrs. (at least).
Strongyles .. .. (*vulgaris* & *edentatus*).	1¼ to 2 hrs.	1¼ to 2 hrs.	1¼ to 3 hrs.	1¼ to 3¼ hrs.
Oxyuris curvula ..	15 mins.	15 mins.	1 to 1¼ hrs.	1½ to 5½ hrs.
§*Spiropteria megastoma*	½ hr.	½ hr.	1 hr.	1 hr.
Taenia (*perfoliata*) ..	15 mins.	15 mins.	15 mins.	15 mins.

It was found that thymol has very little effect on Oestridae even after prolonged exposure in saturated solution. We see from these results that the drug is rapidly fatal to Taeniae and Oxyuridae, less rapidly so to Strongyles and Ascarides. and has practically no effect on Oestridae or on Spiroptera when inside the tumours.

† [A useful bibliography of publications subsequent to 1910 is appended to the original paper.—Ed.]

‡ Abstracted by Mr. T. J. Bosworth, B.Sc., D.V.S.M., M.R.C.V.S.

§ Spiroptera are protected from the action of thymol whilst inside the tumours of the stomach wall. The results here given apply to worms outside of the tumours.

We may conclude that thymol can be successfully employed in the horse as an anthelminthic, and that its action will be greater in proportion to the saturation of the intestinal contents. It is best administered before feeding each morning for four or five days in doses of 10 gm. followed by a good drink of water. If necessary the dose may be repeated in the evening. It is probable that after a few days of this treatment most, if not all, of the intestinal parasites will have been killed. There is nothing to prevent a repetition of this series of doses after an interval of from 8 to 15 days, if required.

NAINSOUTA. **Note sur les gastrodisques. Deux cas de péritonite causés par ces parasites chez des chevaux au Sénégal.** [A Note on Gastrodiscus. Two Cases of Peritonitis caused by these Parasites in the Horse in Senegal.]—*Rec. Méd. Vét.* 1921. June 15. Vol. 97. No. 11. pp. 330–331.*

Gastrodiscus aegypticus is a trematode of peculiar shape and appearance, which reminds one of a small tortoise or a little mushroom without a stalk. It is found in the horse, ass and mule in three countries only—Egypt, Senegal and Guadeloupe. It was probably introduced into the last-named country with animals that used to be imported in large numbers from Senegal. In the same way one can account for the presence of the Senegalese tick, which is identical with the *Hyalomma aegypticus*. In view of the obscurity surrounding the evolution of the trematode, its occurrence simultaneous with that of the tick may be of interest to research workers. In Guadeloupe the tick is responsible for extensive ravages and the gastrodisc causes serious trouble, although elsewhere it appears to be harmless. Two fatal cases in which death was attributed to the latter are described.

First Case.—A horse that had previously appeared quite healthy was seized with violent intermittent abdominal pain and died six hours afterwards. A thorough post-mortem examination could not be made, but the intestines were examined and found to be much inflamed. They contained the parasites in large numbers from the pylorus to the floating colon.

Second Case.—Here again the horse appeared quite healthy up to the time of the attack, when it showed symptoms of violent colic with remissions at intervals, diarrhoea, and pain on pressure of the abdomen. Death occurred in six hours. Post-mortem examination showed the presence of a small amount of cloudy exudate in the abdominal cavity. The parietal and visceral peritoneum was highly congested and infiltrated. The most marked lesion was situated on the first part of the large colon, where a blackish zone of about 50 cm. [*sic*] was seen. On opening the intestine numerous gastrodiscs (400–500) were found lying within the blackish part of the colon, which was distinctly perforated in several places. It was thus clear that the case was one of acute peritonitis following perforation of the colon by the gastrodiscs. Although the examination was made but six hours after death, none of the parasites were found fixed to the mucous membrane and they did not show any powers of movement, so that it appears probable that they only survive their host by a very short time.

* Abstracted by Mr. T. J. Bosworth, B.Sc., D.V.S.M., M.R.C.V.S.

VELU & DUSSERRE. **Echinococcose du coeur et du péricarde.** [Echinococcus Cysts in the Heart and Pericardium.]—*Rec. Méd. Vét.* 1921. Feb. 28. Vol. 97. No. 4. pp. 96–98. With 2 figs.*

The four cases here described were observed during the inspection of Moroccan beef.

No. 1.—The heart showed three small cysts lying close together varying at the apex in size from a pigeon's egg to a turkey's. Their walls were indurated and about 15 mm. thick. They were filled with fluid such as is usually found in echinococcus cysts.

No. 2.—An ovoid cyst attached to the apex of the heart by a short pedicle. The wall was not attached to the pericardium. It was 2 mm. in thickness and contained normal fluid.

No. 3.—Very similar to preceding, but with its wall firmly attached to the pericardium, which showed evidence of reaction even at points not in contact with the lesion. The contents consisted of creamy pus.

No. 4.—Two cysts situated at the level of the auriculo-ventricular furrow on the left surface. One was attached to the left heart and contained a faint brown creamy pus. The other, situated in front and almost on the right heart, contained pus of a distinctly brownish colour. The walls of the cysts were composed of concentrically arranged lamellae and had a thickness of 6 mm. The pressure exerted by the cysts had caused a depression of the heart muscle. (One case was noticed in which a cyst was completely embedded in the heart muscle.)

In no case did the lesions appear to have exerted any harmful influence on the state of the animal's health.

BOUIN & JAZAS. **L'échinococcose dans la région de Marrakech.** [Echinococcosis in the Marrakech District.]—*Rec. Méd. Vét.* 1920. Nov. 30–Dec. 30. Vol. 96. Nos. 22 and 24. pp. 471–475.*

Echinococcus infection is very widespread in Morocco. From observations made in the district of Marrakech it was found that the *Taenia echinococcus* itself is very commonly present in dogs, due no doubt to their eating all the animal offals which are discarded by the natives. Post-mortem examination of 71 dogs showed that 10 of them, or 14·08 per cent., were carriers of the worm. Great numbers of dogs exist in the inhabited districts. Hydatid cysts occur with very great frequency in cattle and dromedaries, but are relatively rare in sheep. The degree of infection varies greatly in the different organs. In the heart and kidneys cysts usually occur singly. In the abattoir at Marrakech hearts are very carefully searched for measles, and during one year eight cases were observed of echinococcus infection of this organ in cattle, equivalent to 1 in 1,000. Two cases were noted in pigs (6 per 1,000). The cysts are often found embedded in the substance of the myocardium and may easily pass unnoticed.

In the lungs and liver the cysts are always numerous and the numbers found are usually in proportion to the age of the animal. In some old animals these organs are literally stuffed with them, the liver especially, so that, although greatly increased in size, it may contain only a small amount of liver tissue. The health of the animals apparently does not suffer in consequence.

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* Abstracted by Mr. T. J. Bosworth, B.Sc., D.V.S.M., M.R.C.V.S.

The great difference in the frequency of infestation of bovine animals and sheep is striking, but can be explained by several reasons, In the first place shepherd dogs are rarely employed. Secondly, during the daytime the flocks are driven out from the villages to graze in the open country, where dogs are few. The pastures are frequently changed, thus allowing an interval for the sun to exert a destructive effect on the worm-eggs. In the evening they are brought back into an enclosure, but are not given any food. Cattle, on the other hand, graze in the vicinity of the villages, where dogs are very numerous, and at night are given a small ration of short straw on the ground in a yard where dogs have wandered all day.

Preventive Measures.—The methods to be adopted for the prevention of the disease consist in the destruction of all infected viscera together with a reduction in the number of dogs. The former course is difficult in view of the apathy of the natives and their disinclination to change their customs, but a law should be made enforcing the destruction of all stray dogs and limiting the numbers kept in each village.

RILEY (William A.) & JAMES (Lyle G.). **Studies on the Chicken Nematode, *Heterakis papillosa*, Bloch.**—*Jl. American Vet. Med. Assoc.* 1921. May. Vol. 59. New Series. Vol. 12. No. 2. pp. 208–217.

The common chicken nematode has hitherto been generally considered to be transmitted by direct infection. However, having in mind the somewhat surprising work of STEWART and of RANSOM recently reported (this *Bulletin*, 1918, Vol. 6, pp. 97–103 and 1919, Vol. 7, pp. 199, 201) on the migrations undergone by the larvae of the common pig and human nematodes (*Ascaris suis* and *lumbricoides*), Riley and James were inspired to undertake a more detailed study of the development of the chicken nematode.

Heterakis papillosa Bloch 1782 (syn. *H. vesicularis* Fröhlich 1791) is the smallest of the ascarid parasites occurring in fowls (males 7–13 mm., females 10–15 mm.); the three lips surrounding the mouth are small and similar in size; the spicules of the male are very unequal in length. The most common related species found in poultry is *Ascaridia perspicillum* Rudolphi 1803, formerly known as a species of *Heterakis*; it is distinguished by the fact that the lips are of unequal size, the upper being the largest; spicules of the male are approximately equal (males 3–8 cm. long, females 6–12 cm.). These two species are the ones most commonly encountered in poultry. *H. papillosa* occurs in chickens and also in the turkey, guinea-fowl, pheasant, peacock, duck and goose. In chickens it is most frequently found in the caeca, although it is not uncommon to find it in the large intestine. Out of over 300 chickens examined by the authors at Minnesota 62·9 per cent. were found infested. ACKERT (1917), at Manhattan, reports a percentage infestation of 74·1; DUJARDIN, at Rennes, France, 56·8; ROTH (1903), at Breslau, Germany, 13 out of 230 chickens examined. Riley and James found the numbers present to vary from 3 to 113 in the fowls examined. ACKERT reports an average of 34·4, but one chicken was found to contain 326 parasites. In rare cases they occur in the caeca in such numbers as to obstruct the lumen, and, according to NEVEU-LEMAIRE, the embryos sometimes perforate the mucosa of the caeca and lodge in its walls.

Development.—LEUCKART (1876) fed a healthy grown chicken with eggs containing embryos and five days later found numerous worms

in the caeca. The eggs had been developing for several months (February–June). He therefore considered the development to take place direct. This experiment was repeated by RAILLIET and LUCET (1892), who fed eggs incubated for three months to a chicken found by faecal examination to be free from helminths. A few days later the bird suffered from diarrhoea, and 31 days later it was killed and 15 specimens of *H. papillosa* were found in the caeca. ERCOLANI (1873) believed that the eggs developed into rhabditiform worms in the excrement, and his feeding experiments were without results, but the organisms seen by him were undoubtedly invading free-living forms.

STEWART (1916–18) found that if a rat or a mouse was fed with the eggs of *A. lumbricoides* the larvae which escaped in the intestines wandered out of the intestines into the liver and later into the lungs, where they underwent development and finally migrated back into the intestines. In the lungs they were capable of causing a serious pneumonia, which sometimes proved fatal. It was suggested, therefore, that rats and mice might act as intermediate hosts. RANSOM and FOSTER (1917–20) repeated and confirmed STEWART'S work, but more extensive experiments showed that STEWART'S hypothesis with regard to rats and mice acting as intermediate hosts was untenable, for development was found to take place without the necessity for a second host, and the discharge of larvae from experimental rats and mice was regarded as " simply the expression of an abortive development in animals imperfectly adapted as hosts." Riley and James found that the common round worm of the cat (*Belascaris cati*) underwent the same cycle of development.

With regard to *H. papillosa*, the eggs are passed in large numbers with the faeces, but the mature worms are not commonly discharged from the host. The freshly-discharged eggs are unsegmented and incapable of development in a new host. Under normal summer conditions segmentation begins immediately when the eggs are placed in water, and the morula stage is reached in four or five days. The rate of development is far from uniform in the same lot. Motile embryos are present in large numbers by the 9th to the 11th day, and in this stage the eggs are infective. The early developmental stages proceed much more rapidly in a dry medium, but the embryos will not attain their full development except in the presence of moisture. Dry cultures which had attained the coiled embryo stage remained latent for six weeks and promptly became motile on the addition of moisture.

Infective eggs were fed to chickens that had been reared in the incubator and protected from any possibility of accidental infection. Within 4½ hours larvae were found to have emerged in the small intestine and at the end of 24 hours numbers were present in the caeca, they now measured 250 μ long by 18 μ in maximum width; distance from anal opening to tip 5 μ. By the 10th day the larvae in the caeca had increased greatly in length (790 μ long by 45 μ maximum width; length of tail 33 μ; alimentary canal conspicuous and gonads clearly outlined). Complete development was attained by the 24th day.

Special attention was devoted to the possibility of any migration of the larvae taking place comparable to that of *Ascaris*. Samples of blood were treated with 2 per cent. acetic acid, centrifuged, and the precipitate searched, but in no case were larvae found. The liver and lungs were separately crushed in a mortar with physiological salt solution thoroughly washed, drained and centrifuged, but again no

larvae were found. The authors therefore confidently assert that the larvae of *H. papillosa* do not, in the course of their development, undergo migrations such as have been found to occur with *Ascaris lumbricoides* and *Belascaris cati*. Their development, it is stated, is simple and direct.

Further experiments were made upon the resistance of eggs to cold and the effect of infestation upon the hosts. It was found that even when infested birds were frozen at temperatures ranging from 0° F. to -10° F. for six months a large number (about 50 per cent.) of the eggs in the caecal contents were still capable of development. A number of the eggs appeared, however, to be affected injuriously.

The symptoms of internal parasitism are loosely dealt with in the literature upon poultry husbandry. Diarrhoea is a frequently mentioned symptom. In a number of the authors' experimental birds diarrhoea was clearly evident, but this symptom occurs so commonly in young chickens that its appearance cannot be considered as evidence of worm infestation. The caeca of chickens infested experimentally showed a marked inflammation, and even in the older birds inflammation and thickening of the walls of the caeca were seen to result from heavy infestation. The authors are convinced, nevertheless, that however vague the symptoms, the worms are a cause of unthrifty condition and a source of loss to the poultryman. When the birds are crowded, or when the seasonal conditions are favourable, the infestation becomes heavy and losses may be direct and serious. GALLI-VALERIO (1897) reported the occurrence in a pheasant of caecal tumours caused by the larvae and this condition was studied in detail by LETULLE and MAROTEL in 1908.

The authors' work on control measures is of particular interest. Remedial treatment is of little real efficacy. Chickens subjected to the tobacco treatment recommended by HERMS and BEACH (1916) were found on post-mortem examination to be on the average as heavily infested as other birds in the flock. HALL and FOSTER (1918) experimented with six chickens and found that this treatment removed 30 out of 162 worms (19 per cent. efficacy). Such results are wholly negligible as a method of eradicating infestation from a flock. It is possible that the treatment would be more effective in removing *A. perspicillum* from the small intestine than it would *H. papillosa* from the caeca.

Failing remedial measures, the next point of importance is to find out whether there is some chemical which when sprinkled on the ground will destroy the eggs and render the poultry yard safe. The great majority of the chemicals recommended for this purpose have already been shown to be useless. The most constantly occurring recommendation of this kind is so-called disinfection by sprinkling the ground with a 1 per cent. solution of sulphuric acid. Riley and James' experiments showed that eggs placed directly in and kept in such a solution readily developed to the infective stage. Moreover, even if the sulphuric acid actually killed the eggs immersed in it, sprinkling the ground or even puddling it with a chemical would be of very doubtful value.

HERMS and BEACH (1916) recommended disinfection by the use of a 1 : 1,000 solution of perchloride of mercury, and an experiment of theirs is quoted in which it was claimed that sprinkling with this solution at the rate of 1 gallon for every 10 square feet of ground, the quantity necessary to penetrate the soil to a sufficient depth, viz., 2 inches, had rendered the infested run quite safe. Riley and

James, however, found that the eggs of the worm could be reared to the infective stage with the utmost ease in a solution of perchloride of mercury in this strength, and the same was true of *A. perspicillum*. The good results claimed to have been obtained by HERMS and BEACH were without doubt due to the thorough cleansing which they gave to the poultry yard and houses in their experiments, while the heavy infestation in the control lot must have been due to the lack of such treatment.

"Trouble from *H. papillosa* and from other intestinal parasites of poultry," the authors state, "is best avoided by the selection of clean, dry runs and well-lighted poultry houses kept thoroughly clean. The ground should be changed every two or three years. Where this is impossible they should be deeply spaded or ploughed, so that the entire surface soil may be turned under. This will not obviate the possibility of parasitic infestation, but will very greatly reduce it."

CHRÉTIEN (A.). **Onchocercose de la région sternale chez un boeuf danois.** [Onchocercosis of the Sternal Region in a Danish Beast.]—*Rec. Méd. Vét.* 1921. March 30. Vol. 97. No. 6. pp. 131–133.*

The lesion was found in the sternal region of a frozen carcass of beef exported from Denmark. It was of the size of a large apple and involved chiefly the fatty tissue on the inferior surface of the sternum at the level of the second and third costal cartilages. More or less spherical in shape, it appeared on section to be composed of a large number of whitish caseous masses which had lost all trace of their original structure but contained innumerable fine calcareous granules scattered irregularly throughout them. These caseo-calcareous masses were very variable in size and shape. Some were distinctly nodular, others flattened, while those in the peripheral part were generally very small in size and appeared to be irregularly cylindrical. These elements were separated from one another by a dense tissue of a glistening whitish colour, and of varying thickness, but not exceeding more than a few millimetres on an average. The lesion was bounded externally by a similar tissue. No communication existed either with the exterior or with the thoracic cavity. The sternum and pleura were normal and the lymphatic glands showed no alteration. No other lesions of onchocercosis were present and the carcass was well nourished and of good quality.

Histologically the lesion appeared composed of a series of completely degenerated nodules becoming smaller in size from the centre outwards. In the peripheral region some of them were perfectly cylindrical in shape. After decalcification the nodules appeared quite homogeneous and stained a light violet colour with haematein. They did not show any cellular elements, however, either intact or in the process of degeneration. The tissue in between the nodules appeared to be the result of a subacute or chronic inflammation. It was composed of interlacing fibres infiltrated with eosinophile cells, with occasional blood-vessels, and its inner surface was lined in places with a faint epithelioid layer. The tissue on the outside of the lesion was of precisely the same structure, so that the whole thing may be looked upon as a dense mass enclosing nodules of varying size, which had

* Abstracted by Mr. T. J. Bosworth, B.Sc., D.V.S.M., M.R.C.V.S.

completely undergone a caseo-calcareous degeneration. The surrounding tissues appeared normal except for considerable thickening of the walls of some of the neighbouring vessels.

Microscopical examination failed to reveal any causal organism. No tubercle bacilli could be found. A guinea-pig inoculated subcutaneously with ground-up substance from the lesion did not show any reaction. No worms either in the adult or larval stage could be seen, and no moulds were present. The lesion cannot have been tuberculous since no bacilli could be demonstrated by microscopical examination or guinea-pig inoculation. Further, no giant cells were present. The numerous eosinophile cells found in the tissue between the nodular masses suggest a parasitic lesion, and the cylindrical caseo-calcareous elements round the periphery would indicate a nematode. The lesion very much resembles those of onchocercosis met with in Australia and New Zealand, which frequently necessitate condemnation of the brisket of beef. An identical lesion has not previously been reported as occurring in Europe, but it seems probable that this case is more likely one of onchocercosis than of any other condition.

SCHWARZ (Benjamin). **Effects of X-Rays on Trichinae.**—*Jl. Agric. Res.* 1921. Mar. 1. Vol. 20. No. 11. pp. 845–854.*

This article is a description of experiments conducted to ascertain the effects of exposure to X-rays on trichinae, with a view to the practical application of X-ray radiation to the destruction of trichinae in pork. A number of hogs were infected artificially by feeding them on trichinous pork, and were then killed after an interval of about one month. Their flesh was submitted to exposure to X-rays, after which it was chopped up and fed to rats in order to determine the effects of the exposure. In a few cases portions of the meat that had been exposed to X-rays were digested in an acidified solution of scale pepsin, the decapsuled larvae were examined, and the results were compared with those of the feeding experiments. Unless they died as a result of infection with trichinae, the rats were killed at various intervals, and examined for evidence of infestation with the parasites.

The results show that encysted trichinae are injured by relatively heavy dosages of X-rays. The injuries are not visible in the encysted or artificially decapsuled larvae as structural or functional disturbances, but become apparent only when the larvae reach a suitable host in whose intestine they are normally capable of continuing their development. Trichinae from meat that has been exposed to strong dosages of X-rays undergo rapid granular degeneration in the intestines of suitable hosts. When, however, they have been exposed to lower but still injurious dosages, they are able to continue development in the intestines of suitable hosts, but do not attain structural and functional sex maturity. The sex cells appear to be atrophied, and no evidence of successful copulation can be found. The trichinae appear also to exhibit considerable variation in their susceptibility to X-rays, since certain dosages injured some parasites and failed to injure others. Small dosages apparently had little or no effect on the subsequent development of the parasites.

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These results do not warrant any definite conclusions, for, assuming that a reliable practical method of destroying the vitality of the sex cells in trichinae by means of X-ray treatment of infested meat can be perfected, unless the treatment has the effect of diminishing the injurious action of the intestinal stage of trichinae upon the host it cannot be considered a satisfactory prophylactic measure.

HALL (Maurice C.). **Examining Feces for Parasites and Parasite Eggs.**— *Vet. Med.* Chicago. 1921. Sept. Vol. 16. No. 9. pp. 52–54.

In this paper Hall describes simple methods by which the veterinary practitioner may determine the presence of parasites or their eggs in faeces. Wherever practicable the faeces should be screened. Those of the dog, cat, and pig may be broken up in water and screened without difficulty. Sheep and goat faeces are much more difficult to manipulate though they can be screened to advantage in looking for parasites. Cow manure is easily screened, but its bulk makes the examination of a day's manure a difficult task. Horse dung is too coarse to screen successfully in the amounts passed in one day and must be examined by being carefully picked apart by hand. The nature of the screen used depends on various circumstances. Where few examinations are made and little apparatus is available a piece of cheese cloth may be stretched over hoops or a bucket top to make a screen. Where routine examination of faecal matter is undertaken, wire screens, of copper or brass, of assorted sizes of 6–100 mesh apertures to the inch are of value. After the faeces have been broken up thoroughly by soaking them in water and shaking, they are poured through the screen or screens and each screen is then put in a glass dish containing water and examined for parasites.

When the eggs of parasites are searched for by microscopic examination, the simplest method is to make a smear of a small piece of faeces on a slide, rub it up with a little water to form a uniform paste, and examine under the microscope. This method gives satisfactory evidence when there is gross infestation, but it is not a delicate method, and cannot be depended upon to detect light infestations. A simple method that will give a high degree of concentration is as follows :—

The faeces are broken up, screened through a set of screens placed in a rack with the coarsest screens at the top and the finer ones at the bottom, the material passing through all the screens being caught in a suitable tray or dish. After standing for about a minute the upper half of the fluid is decanted away and replaced by clean water. This process is repeated every minute until the soluble colouring matter and floating flocculent matter is all poured away and the water stands clear on the sediment at the bottom. The water is then decanted away until only a little is left on the sediment, and this is shaken up and poured into a centrifuge tube until the tube is full. The tube is then set in a rack until the examination is performed. In the course of this manipulation all faecal material which is too coarse to pass through a screen with 100 apertures to the inch has been eliminated by the screens, while, on the other hand, such screens will allow the passage of the largest parasite eggs one need take into consideration, and the soluble colouring matter and floating flocculent material eliminated by the washing and sedimenting. What is then left is the the eggs and other material of about the same size as the eggs or other smaller and heavy material. When there is a bottom sediment,

evidently composed of sand, in the tray or dish used to catch the faeces passing through the screen, this should be allowed to remain in the dish and not rinsed into the test-tube, as the eggs are lighter and will be on top of such a sediment.

By this method a high degree of concentration is obtained, and it is applicable to a wide range of animals. Hall states that there are many published methods for examining faeces for parasite eggs, but most of them are intended only for human faeces, which is a very special case, and some of them only for hook-worm eggs, which is again a very special case. They are more or less elaborate, although sometimes very useful within the range of their applicability. For the purposes of the veterinarian the simple technique given here and intended for faeces of any sort and the detection of parasite eggs of any sort is recommended. It has to be borne in mind, however, that failure to find eggs in faeces with any technique is not conclusive proof that no worms are present. In very light infestations the few eggs present in faeces may not be observed in the preparations examined. Where only male nematodes are present there will be no eggs in the faeces. Where only larvae or young worms are present there will be no eggs, and egg production may be interrupted or terminated by old age, anthelmintics, or accidents.

MARCENAC. **Dermatose par** *Ixodes ricinus.* [Dermatitis caused by *Ixodes ricinus.*]—*Rec. Méd. Vét.* 1921. Jan. 30. Vol. 97. No. 2. pp. 58–61.*

Symptoms of this condition are first noticed about 24 or 36 hours after horses have been admitted to infested land, which is usually covered with heather or broom. If the hand be passed over the animal's body, indications of a dermatitis are obtained in the shape of pimples and oedematous patches. After a short time thick yellow scales are seen, and the hair becomes matted in tufts that easily come away when pulled, leaving an irregular smooth surface which is moist and painful. Adult male and unfertilized female ticks come away with the scabs, but most of the fertilized females, which are engorged and of enormous size, have their rostra firmly implanted beneath the skin and are only detached with difficulty. The ticks are found chiefly in places where the animal cannot reach them with its teeth (parotid region, jowl), or where the skin is fine (elbow, belly, inside the thigh and forearm). They are not usually present on the trunk above a horizontal line passing through the junction of the middle and lower thirds of the ribs, nor on the limbs below the middle of the forearm and gaskin. The irritation set up is very marked and the animals bite themselves freely. Some subjects become so nervous and excited that they are very difficult to approach. In severe cases there are numerous cutaneous lesions which, by confluence, become converted into large, hairless, irritable patches, that heal but slowly and are analogous to the effects of a strong blister. The lesions on the upper part of the limbs may cause marked oedema accompanied by lameness. Provided treatment is applied early, the lesions terminate rapidly without complications. Prompt attention should be given not only to prevent extensive damage to the skin, but also to ensure the destruction of the female ticks before they drop off in readiness

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to lay their eggs. Complications may result in the shape of painful miliary abscesses in cases where the rostra are left under the skin after removal of the ticks by an attendant or by the horses' teeth.

From the point of view of prevention, the possible infestation with ticks must be considered whenever horses are obliged to cross moory or waste land. In such cases it is advisable to wash the body over with a warm solution of cresyl, or to rub it with a sponge dipped in benzine and then rung out so as to contain only the vapour.

A satisfactory curative method consists in sulphur fumigation. One passage of 30 minutes in the chamber is sufficient to completely free the animals of all the ticks they carry. In advanced cases attention to the lesions is necessary in addition. Eradication by hand is not recommended owing to the length of time involved and the difficulty experienced in extracting the ticks whole.

MYCOTIC DISEASES.

FORGEOT. **Essais de traitement de la lymphangite épizootique par les cultures, chauffées, de Cryptocoques.** [Attempted Treatment of Epizootic Lymphangitis with Heated Cultures of the Cryptococcus.] —*Rec. Méd. Vét.* 1920. Nov. 30–Dec. 30. Vol. 96. Nos. 22 and 24. pp. 489–492.*

This article gives a detailed account of the treatment of 20 horses suffering from extensive lesions of epizootic lymphangitis. The vaccine employed was prepared by NÈGRE and BOQUET from a two months old culture of the cryptococcus and was made up in a strength of $\frac{1}{2}$ mgm. per cc. of normal saline solution. The first animal received an initial dose of 1 cc. subcutaneously. On the following day it was noticed that the lesions showed congestion and discharged more freely. Further injections were made every eight days, the dose being increased by 1 cc. each time up to a maximum of 5 cc. A complete cure resulted in six weeks. The inoculation causes a local lesion at the point of injection, which is hot, painful and oedematous, and about the size of the palm of one's hand. Partial reabsorption takes place, followed by the formation of an abscess which rapidly heals after evacuation.

The second animal was treated exactly similarly, but showed no improvement after seven inoculations had been performed. It was therefore decided to try the effect of a vaccine of ten times the strength (*i.e.*, 5 mgm. of culture per cc.), which was administered in the same doses as before, beginning with 1 cc. After seven injections the animal was cured.

In subsequent cases the stronger vaccine was employed, the only other treatment consisting of puncture of the abscesses as they arose and application to the ulcers of a solution of methylene blue in glycerine (1–50).

Of the 20 animals treated 13, or 65 per cent., were cured. Of the remainder 3 were in such an advanced stage before treatment was begun that it was unreasonable to expect good results. The average duration of the treatment was 57 days. The general health of the

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animals was unaffected by the vaccine. No relapses have occurred. This method of treatment is easily carried out, promises good results, and is worthy of further trial.

Cocu (M.). **Traitement de la lymphangite épizootique.** [Treatment of Epizootic Lymphangitis.]—*Rec. Méd. Vét.* 1920. Nov. 30–Dec. 30. Vol. 96. Nos. 22 and 24. pp. 501–502.*

Cocu records a case of epizootic lymphangitis with very extensive lesions that was successfully treated by the use of drugs by Bridré and himself. Confluent lesions were present in both fore limbs, together with very thick corded lymphatics, on the scrotum and sheath, round the lips and nostrils, and on the pituitary membrane. The internal surface of one of the tibias showed a large exostosis due to the deeper layers of the periosteum, or perhaps the bone itself, being involved. With the exception of opening a few abscesses, treatment was purely medical and consisted of intravenous injections of novarsenobenzol and potassium iodide. A complete cure was affected in three months. After five years the animal was perfectly healthy and the exostosis, though still noticeable, was considerably reduced in size.

The author also mentions a second case with advanced confluent lesions that yielded to medical treatment alone, of which the exact details are not available, but which consisted in injections either of a solution of biniodide of mercury or of the double solution of methylarsenate of soda and benzoate of mercury, which has proved effective in the treatment of pernicious anaemia in horses.

Descazeaux (M.). **Le traitement de la lymphangite épizootique par le novarsénobenzol.** [Treatment of Epizootic Lymphangitis by Novarsenobenzol.]—*Rec. Méd. Vét.* 1921. June 30. Vol. 97. No. 12. pp. 274–278.*

The author claims to have been successful in treating cases of epizootic lymphangitis with injections of novarsenobenzol. Eighteen cases were subjected to this method, of which eight had not received any previous treatment. The other ten had received injections of the cryptococcus killed by heat, and, excepting two, which appeared incurable, had shown improvement as a result.

The dose of novarsenobenzol was varied according to the susceptibility of the animals to the drug, doses of 1½, 2 or 2½ gm. being given daily, until a total of from 6–8 gm. had been given, corresponding to the normal therapeutic dose of 0·015 gm. per kilogramme body weight. This series of injections was repeated after eight-day intervals. A short negative phase was seen to occur after the first series, followed by a positive phase which lasted until the animal was cured. Four series were found to be necessary in cases of average severity, whereas only two were required for mild ones. Recovery took place in all the cases.

It was noticed that the earlier the treatment was begun the quicker was the animal cured. It is therefore important to make an early diagnosis and begin the injections at once. Attention should also be paid to any wound present at which the cryptococcus may have gained access to the body. For this purpose a 45 per cent. solution of formol or novarsenobenzol powder proved to be a useful application.

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Complications.—In two cases during the healing process, when the corded lymphatics and nodules had disappeared, several abscesses were seen in the neighbourhood of the cicatrized lesions, which were found to contain only a few cryptococci but numerous staphylococci (*aureus* and *albus*). These healed after evacuation without further treatment. In another case a large angry-looking wound was present, which at first showed signs of healing but later became worse and suppurated freely. The discharge contained numerous organisms—staphylococci, streptococci, bacilli. At the same time fresh corded lymphatics and buds appeared, the pus of the latter showing cryptococci and staphylococci. It therefore seems that staphylococci can, at a given moment, complicate lesions due to cryptococci and retard their healing, and probably other organisms may have the same effect. On these grounds it would appear reasonable to combine vaccine therapy with novarsenobenzol in intractable cases. Bacterial complications (staphylococci especially) undoubtedly play an important part in the pathogenicity of epizootic lymphangitis. The history of 24 animals suffering with the disease revealed the fact that all had been treated from one to four months previously for wounds, which, when the lymphangitis appeared, proved to be the starting point of the corded lymphatics. In all these wounds staphylococci predominated, and it is probable that their effect was to render the animal susceptible by means of toxins secreted in the wound itself, which, becoming diffused in the neighbouring lymphatic network, were favourable to the development of the cryptococcus, which was no doubt inoculated at the same time. Similarly, in the course of the disease, reinfection of the wound with other organisms is liable to cause an aggravation of the effects of the cryptococcus. These considerations may explain the fact that autogenous vaccines made from the pus sometimes seem more efficacious than others, because they at the same time vaccinate against bacteria which may be complicating the disease.

ROGER (J.). **Au sujet de la présence d'un cryptocoque dans certaines dermites granuleuses.** [The Presence of a Cryptococcus in Certain Forms of Granular Dermatitis.]—*Rec. Méd. Vét.* 1921. July 30. Vol. 97. No. 14. pp. 316–318.

With the approach of summer the author observed in certain districts in the south of France a condition known to the local veterinarians as "summer sore," characterized by its slow healing during the hot weather, presence of soft buds which easily bleed, a serous pus, fibrinous exudate, caseous granulations, and intense induration of the dermis. This induration is held to be characteristic and enables one to distinguish the disease easily from simple sores. Certain horses exhibit these sores every year and the lesions are apt to recur at their former seats. Sometimes small secondary centres are formed around the principal centre, which would appear to indicate that the condition has a tendency to spread. In some cases the induration is so marked that the lesion resembles an ulcerating tumour.

At the present time "summer sore" is considered to be the result of the irritation produced by the larvae of a gastric Habronema transported by the domestic fly on to the surface of the sore. Roger, however, found no such larvae in the sores that came under his observation, but, on the other hand, all revealed the presence of a yeast-like organism (Blastomycetes), which, in the meantime, he

regards as a cryptococcus. If a smear is made from the pus of a recent sore one finds scarcely any bacteria, but on the other hand a large number of large mononuclears and polynuclear leucocytes, together with a rounded, oval, or pear-shaped element, encapsuled and of varying size, free or included in the phagocytes. Some of these structures were scarcely larger than eosinophile granules, but could be easily differentiated by the presence of a capsule, although some were as large as RIVOLTA's cryptococcus of epizootic lymphangitis. The free-lying parasites were collected in more or less considerable masses of various shapes. They were usually so numerous that there was no difficulty in finding them, and the caseous granules seemed to be composed almost entirely of the structures. The best method of staining is by means of a methylene blue eosin stain after rapid fixation with alcohol ether mixture. Three zones can be sometimes easily distinguished, viz.: (1) round or oval central zone staining deeply with eosin; (2) a refractile capsule around this zone; and (3) a bluish zone encircled by a border of deeper blue. This last zone was not constantly found. The parasites were not stained with dilute fuchsin. This structure was found in 16 horses, some of which showed several summer sores, but none of them were complicated with lymphangitis. [It would be interesting to have had reported a more complete study of this condition.—J. T. E.]

BACTERIAL DISEASES.

VELU (H.). **Le charbon bactéridien chez le porc au Maroc.** [Anthrax in the Pig in Morocco.]—*Bull. Soc. Path. Exot.* 1921. July 13. Vol. 14. No. 7. pp. 359–361.

In Morocco, anthrax in the pig usually shows itself as an affection involving the pharyngeal region (so-called "gloss" anthrax), but sometimes septicaemic forms are seen which are difficult to differentiate from the other so-called "red" diseases, especially inasmuch as the spleen is not enlarged and the blood reveals very few bacilli. The disease therefore undoubtedly frequently passes unobserved.

In this note, Velu records an exceptional type of infection, viz., a pulmonary form which hitherto appears to have been described only by PASSERINI and then by WYSSMANN, E. (1907) in the pig. The subject was a nine months old sow which showed ill-defined symptoms, intense fever, slight swelling of the neck, marked dyspnoea and livid spots on the skin. The animal died in 48 hours. Hardly any congestion was found in the various visceral organs. The spleen was normal; there was a slight swelling of the pharyngeal lymphatic glands. However, in the thoracic cavity there was a distinct pericarditis and pleuritis, and the right lung was the seat of an intense grey hepatization recalling in appearance somewhat the lesion of contagious bovine pleuro-pneumonia. Anthrax bacilli were recoverable from the pleuritic fluid, but could not be obtained in culture from the heart blood nor seen in smears from the blood, gland juice, kidneys, or spleen.

BESREDKA (A.). **Vaccination par voie cutanée. Charbon : cuti-infection, cuti-vaccination, cuti-immunité.** [Vaccination by Way of the Skin. Anthrax: Cutaneous Infection, Vaccination and Immunity.]—*Ann. Inst. Pasteur.* 1921. July. Vol. 35. No. 7. pp. 421–430.*

The classical method of anti-anthrax vaccination, which is so successful in the larger animals, fails almost always in the case of the small laboratory species. If more than the minimum lethal dose (⅛ cc. of second vaccine in the guinea-pig or the least fraction of a cc. in the rabbit) is given, it is rare for these animals to offer any resistance, no matter how carefully and gradually one has attempted to immunize them.

The author had noticed, however, that a strong local reaction is set up in the guinea-pig by painting a shaved area of the skin with a swab soaked in the first anthrax vaccine. On the following day a marked characteristic inflammatory reaction appears, which shows no tendency to spread. After persisting for four to six days it gradually abates, the skin becoming pale and supple again. The application of the second vaccine to a normal guinea-pig, on the other hand, causes a much more marked reaction, which does not remain localized, but spreads more and more into the surrounding tissues until it becomes generalized, causing the death of the animal in about four days. If, however, a guinea-pig, which has recovered from the effects of the application to its skin of the first vaccine is subsequently treated in a similar manner with the second vaccine the reaction remains circumscribed and in a few days the skin becomes normal again. After an interval of ten days the application of a virulent bouillon culture of anthrax to the shaved skin of such an animal will cause a very marked reaction, but the animal will recover and will then withstand subcutaneous injection of repeated and increasing doses of culture, and have thus acquired a very solid immunity. In the same manner the rabbit can be vaccinated against anthrax, and in this animal it is best to begin with the second vaccine, followed after an interval by virulent culture. When the skin has regained its normal appearance the immunity is sufficiently strong to afford protection against the organism, by whatever channel it may be introduced.

A similar immunity may be set up by intradermic injection, *i.e.*, into the thickness of the skin itself.

Having succeeded in immunizing these small laboratory animals against anthrax, the author withdrew blood from them and used the serum for injection into normal guinea-pigs, to ascertain whether it would confer on them any protection against inoculation of the organism, but it proved to be entirely useless for this purpose, the disease taking exactly the same course in those animals that had received serum as it did in the controls. Apparently, therefore, the immunity set up by cutaneous vaccination is not due to the production of specific antibodies in the blood.

It then occurred to the author that possibly in the guinea-pig there is only one organ for which the anthrax bacillus has a real affinity and in which it can establish itself and multiply, this organ being the skin, outside of which it is bound to be destroyed wherever it enters the body. An animal inoculated with anthrax intraperitoneally or intratracheally succumbs in the same manner as one inoculated cutaneously or subcutaneously, but this is because in inserting and withdrawing the

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needle one is bound to wound the skin and infect it with the bacillus, and it is this infection of the skin which determines the death of the animal. If this supposition be correct, then it should be possible to inject anthrax bacilli into guinea-pigs with impunity, provided one avoids contaminating the cutaneous structures with the organism. Experiments which were performed proved that, when this precaution is taken, it is possible to inject many times the ordinary fatal dose either into the trachea, peritoneum or veins without causing the animal any inconvenience. The operation is a delicate one and may not always succeed. Oedema appearing at the point of inoculation is a clear indication of faulty technique.

These results show that the susceptibility of the guinea-pig to anthrax is mainly, if not entirely, confined to its skin. It is therefore easy to understand how a guinea-pig which has been vaccinated cutaneously shows such remarkably powerful immunity, and, further, how a local immunization, confined to the skin alone and not due to the development of antibodies in the blood, can confer an immunity on the whole animal body. It is because the guinea-pig possesses but one sensitive organ, viz., the skin, and as soon as this has been immunized the animal has nothing to fear. Whether virus be subsequently introduced by way of the peritoneum, respiratory passages, or even the blood stream, it is opposed firstly by the barrier of the vaccinated skin, and secondly by the natural refractory state of the other organs.

A very interesting point is the fact that a guinea-pig which has received very large doses of anthrax bacilli injected into the peritoneal cavity or into the trachea (with precautions to avoid contamination of the skin) does not develop any resistance to anthrax as a result. If it is subsequently inoculated with anthrax by subcutaneous injection in the ordinary way it succumbs in just the same manner as a control animal. The bacilli which penetrate otherwise than by the skin or subcutaneous tissue evidently pass almost unnoticed by the animal, being immediately phagocyted and digested. They must be totally and rapidly destroyed, for they leave no effect upon the animal.

The guinea-pig is commonly cited as being very susceptible to anthrax and incapable of being immunized against it. The classical reason assigned for the impossibility of immunizing the animal against the bacillus is that it is remarkably susceptible to it. It is now seen, however, that the guinea-pig is very resistant to anthrax, provided the organism is not introduced into the skin, and, moreover, that immunization is easy if care is taken to vaccinate the skin. When dealing with an infectious or toxic agent it is not sufficient to inquire whether a given animal is susceptible. An endeavour should be made to determine whether it possesses an organ particularly sensitive to the agent in question, and, if so, whether by vaccinating that organ the animal may not be completely immunized.

DISEASES DUE TO FILTERABLE VIRUSES.

ARLO (J.). **La rage canine au Soudan français.** [Canine Rabies in the French Soudan.]—*Bull. Soc. Path. Exot.* 1921. July 13. Vol. 14. No. 7. pp. 368–373.

Rabies has been proved to exist in dogs in the French Soudan by a number of authors, but the virus seems to exhibit certain peculiarities, particularly that of low virulence, so that examples of transmission to the human subject are extremely rare. In 1919 Arlo commenced studying the native virus and first endeavoured to obtain a fixed virus. His attempts, however, proved fruitless. The brain of one dog gave fatal rabies to a rabbit after sub-dural inoculation, but inoculation of a second rabbit with material from the brain of the first rabbit remained negative. Virus from the brain of a second dog was passaged through a series of rabbits, but after about 13 months it died out, and in the meantime there was no evident shortening of the period of incubation in the inoculated rabbits; in fact, the period increased from 21 days for the first rabbit to 128 days for a rabbit inoculated six months later. Some of the rabbits remained alive in spite of inoculation. Likewise material obtained from the Dakar Laboratory could not be exalted in virulence, and some of the samples proved quite inactive. The temperature of inoculated animals was taken for some time twice daily, but only in one case was a rise noted prior to death. Glycosuria could not be detected. In the case of one rabbit the virulence of the medulla, salivary glands, and sciatic nerve were compared. The medulla only proved virulent, and the animal inoculated with it died in 74 days. In 1910 BLANCHARD noted that a rabbit which had been inoculated with rabies during the preceding year, and had remained healthy, succumbed with typical symptoms of this disease following upon the application of cowpox virus to the dorsal region. Arlo repeated this experiment upon three rabbits, with negative results.

The author was unable to detect the presence of Negri bodies in the hippocampus of any of his animals. The form of rabies occurring in the Soudan does not appear to be transmissible to man, and a child about four years old that had been bitten on the face near the lips remained healthy subsequently. [See, however, preceding number of this *Bulletin*. pp. 173–174.]

VAN SACEGHEM (R.). **Procédé pour la production rapide du sérum contre la Peste bovine.** [A Rapid Method of Producing Anti-rinderpest Serum.]—*Bull. Soc. Path. Exot.* 1921. July 13. Vol. 14. No. 7. pp. 367–368.

In hyperimmunizing serum-producing animals the author resorts to direct transfusion of virulent blood from rinderpest-affected animals. The procedure is simply carried out by connecting a trocar placed in the jugular vein of the diseased beast with an india-rubber tube which is attached to a trocar placed in the jugular vein of the animal which is being hyperimmunized. In order to facilitate the flow of blood, the animal which is the source of the virulent blood is placed about five feet above the level of the ground and pressure applied to its jugular vein below the trocar. The pressure thus obtained is also sufficient to perform a subcutaneous inoculation with blood. Three or four litres of blood can thus be transfused easily in five minutes intravenously.

[The author, working in the Belgian Congo, does not state how many cattle he has subjected to this process. It is our belief that elsewhere workers have found this method of hyperimmunization result in the production of severe symptoms of shock, and often death, in the injected animals.—ED.]

i. CROVERI (P.). **A propos de la vaccination contre la peste bovine par le procédé de Schein.** [Vaccination against Rinderpest by SCHEIN'S Method.]—*Bull. Soc. Path. Exot.* 1921. Jan. 12. Vol. 14. No. 1. pp. 9–15.

ii. SCHEIN (H.). **Vaccination contre la peste bovine.** [Vaccination against Rinderpest.]—*Bull. Soc. Path. Exot.* 1921. July 13. Vol. 14. No. 7. pp. 361–367.

i. In 1917 SCHEIN described a method of conferring active immunity upon highly susceptible animals, such as the buffaloes of French Indo-China, differing from the original method of sero-vaccination described by KOLLE and TURNER, inasmuch as a small dose only, viz., 1 cc. of a 1 : 1,000 dilution of virulent blood was injected at the same time as the protective dose of serum. [See this *Bulletin*, 1918, Vol. 6, No. 1, p. 32.]

Having in mind the undeniable superiority of such a method, Croveri carried out a few experiments with it upon Somaliland cattle, but the results were, however, disappointing, as a solid immunity was not set up against subsequent test inoculations. It would seem that the good results claimed by SCHEIN were in reality probably due to contamination with the virus from outside sources, while the serum injections still maintained a passive immunity. Moreover, Croveri claims highly successful results following upon the use of the original form of double inoculation in Italian Somaliland (0·6 cc. virulent blood withdrawn on the fifth day of the disease and 25–50 cc. of a serum according to the weight of the animal). For example, out of 1,000 adult animals vaccinated a febrile reaction was obtained in all, with subsequent active immunity against the disease. Again, the susceptibility of cattle in Somaliland appears to be even greater than that reported by SCHEIN in Indo-China; thus, from 90–95 per cent. of Somaliland cattle succumbed in the course of outbreaks, especially during the rainy seasons, whereas in Indo-China the mortality was said to be 43 among buffaloes and 29 per cent. among cattle. The percentage of animals which exhibited reactions in SCHEIN'S trials was much below that observed by Croveri after the use of the original method.

In Croveri's experiments four animals vaccinated according to SCHEIN'S method did not react, but three months later, after being subjected to the original method of vaccination, they showed typical reactions. It would thus appear that they had not been actively immunized as the result of the first inoculation. SCHEIN, however, expresses regret that the author had not kept any controls for his first and second experiments, but simply assumed that the virulent blood was at its maximum activity on the fifth day of the disease. Croveri maintains that the virulent blood thus injected could be regarded as a good sample, inasmuch as it contained a strain of virus which had been maintained at the Serum Institute for five years and had been maintained by passage every eight days and was highly virulent and infective. At the time of the first inoculation the virus

was used for infecting four virus-producing calves, which fell ill three days afterwards, and for the vaccination of 50 calves, which subsequently gave typical reactions. Further, as regards the second test, viz., by vaccination according to the original method, controls would only have been necessary had the calves exhibited no reaction. Croveri thus concludes that the results fail to lend any confirmation to SCHEIN'S conclusion.

ii. Schein contends, however, that CROVERI'S experiment is inconclusive, as he did not utilize at least one control in the form of an animal inoculated with 1 cc. of the 1 : 1,000 dilution of blood, without simultaneous injection of serum, in order to ascertain the infectivity of this dilution. Again, the quantity of serum injected by CROVERI might have been so large as to mask a reaction due to the small dose of Somaliland virus. [Schein's argument displays some weakness, particularly when he speculates upon the possibility of a partial immunity being conferred by CROVERI'S first injection.] Schein maintains it would have been difficult to take account of febrile reactions in the animals vaccinated by him in the jungle. After the use of the original KOLLE-TURNER method in French Indo-China, from 1–3 per cent. of cattle died, 7–10 per cent. became seriously ill, 20–30 per cent. showed clinical symptoms, 40–50 per cent. showed simply a fever which subsequently conferred immunity; 6–10 per cent. are naturally immune, and 6–7 per cent. fail to contract the disease and are thus not vaccinated. If, therefore, 30–40 per cent. of the buffaloes and 40–50 per cent of the cattle become apparently clinically affected, then at least 40–50 per cent. might be assumed to be fevered. Moreover, reactions were always obtained in the laboratory following upon the injection of a dose of 1 cc. of a 1 : 1,000 dilution of virulent blood, with or without serum. In support of his contention that this small dose of blood was in reality infective, Schein further quotes the cases of an establishment where the herd had been completely exterminated by rinderpest. After the lapse of a sufficient period of time to bring about the disappearance of the virus, 65 working oxen were purchased from a healthy district and vaccinated—using diluted virus. All gave a temperature reaction in four days (39°–40° C.), and 12 presented clinical symptoms. Three of these died in 30 days. The remaining animals proved to be immune in spite of the fact that they were exposed subsequently to infection. [Such an argument is not in conflict with CROVERI'S argument regarding the possibility of external contamination.—ED.]

Schein states that in French Indo-China attempts at vaccination were carried out by him on the borders of the infected zone in villages separated from each other by a distance of about three miles at least. The animals belonged to about 250 different owners possessing at most five or six animals each. The disease had just appeared in one village, causing two deaths. When serum alone was employed in such circumstances about 20 animals would be noticed ill in about 10 days after the operation, and thenceforward the disease developed for two or three months as on virgin ground. Thus in Indo-China the use of serum alone as a preventive had been discontinued entirely. On the other hand, in the villages in which Schein adopted his method of conferring active immunity, all the animals which exhibited clinical symptoms were attacked at the same time, viz., in from eight to ten days after the injection, and the disease lasted from eight to ten

days, and afterwards conditions returned to normal. In this manner Schein attempted to establish an immune belt of cattle, a result which could not be achieved by the use of serum alone. The dose of serum recommended for the buffalo is very large, viz., 50 cc. per 100 kgm. body weight, while cattle receive from 40–80 cc. according to their size and age. Schein concludes that CROVERI's single negative experiment does not invalidate the numerous controlled positive results obtained by him in the laboratory and in the field.

[This subject appears to be of great importance, inasmuch as a safe method of conferring active immunity upon highly susceptible animals against rinderpest is a much desired object. Schein's attempts to elucidate this problem merit attention. However, it cannot be said that he has convincingly proved that safety is obtained by using a very small dose of virulent blood or that the employment of such a dose is with certainty superior to that of the bigger dose of the original method.]

RUPPERT (F). [**Precipitin Reaction in Rinderpest.**]—*Deutsche Tierärztliche Wochenschrift.* 1919. Sept. 20. [Extracted in *Clinica Vet.* 1919. Dec. 31. Vol. 42. No. 24. pp. 729–730.]

In the course of his researches upon rinderpest at the Serum Institute at Mpapua, in what was formerly German East Africa, the author frequently found great difficulty in arriving at a definite diagnosis of rinderpest; the conditions with which the disease might be easily confounded were, in particular, malignant catarrh, East Coast fever, and a form of paralysis which is common in Africa. The lesions which are usually stated to be associated with rinderpest in the stomach and intestines were absent in more than 60 per cent. of the cases examined. The author performed some tests which would appear to indicate that there is present in the serum of highly hyperimmunized animals an antibody which is capable of provoking a distinct specific precipitin reaction. When, therefore, serum from a beast which has received a few litres of blood from an animal at the height of an acute attack of rinderpest is added to a clear chloroformed extract of an animal dead of the disease, a reaction is observed in the form of an opaque zone at the meeting of the fluids even when the hyperimmunized serum is diluted 20 times. With 25 organs of rinderpest animals obtained from various sources positive results were obtained in all of them, whereas negative results were obtained in all cases with serum and normal extracts, or extracts in normal saline. Likewise negative results were obtained with extracts of organs of cattle affected with East Coast fever and redwater. In positive cases the ring at the zone of contact appeared comparatively rapidly and was apparently completely formed in a minute. Further researches on methods of sero-diagnosis were interrupted by the outbreak of war.

VALLÉE (H.) & CARRÉ. **Hémoprévention et hémovaccination antiaphteuse.**—*Rec. Méd. Vét.* 1921. July 15. Vol. 97. No. 13. pp. 369–372.

The specific properties of the blood of cattle recovered from foot-and-mouth disease have been made known for many years by the researches of LÖFFLER and FROSCH, PERRONCITO, ROUX, NOCARD, Vallée and Carré.

Confronted with the impossible task of obtaining a sufficient quantity of efficacious anti-foot-and-mouth disease sera, various authors have been naturally tempted to utilize in the struggle against this redoubtable epizootic disease the blood or the serum of animals that have recovered from an attack (PERRONCITO, KUYPERS, BEIJERS, BROERSMA, AUKEMA, LEBAILLY, DESLIENS, etc.).

While some of these authors have been entirely satisfied with the result, others have cast the gravest doubt upon them, and thus Vallée and Carré considered it necessary to collate and compare the results published in the literature and submit them also to an experimental trial. They therefore resumed their original work, prosecuted with NOCARD and ROUX in 1902, and they now state that they are in the position to formulate certain definite statements with regard to the value of immunization and the conditions in which it should be employed. These statements are summarily expressed as follows :—

1. Cattle recovered from foot-and-mouth disease do not all furnish, even when exposed to like conditions of infection, bloods which are equally active ; this fact is, of course, on analogy with what is known to occur in animals destined to produce various therapeutic sera experimentally. In order therefore to obtain uniform results in the adoption of methods of treatment involving the inoculation of blood, it is necessary to utilize to the widest extent possible a uniform mixture of citrated bloods, withdrawn from quite a number of animals, on the 12th to the 15th day after the appearance of vesicles. In no case should blood withdrawn from a single convalescent animal be utilized, no matter how severe the infection it has suffered from appeared to be. Moreover, in judging the severity of the progress of the disease in an animal, great care should be taken not to confound the effects attributable to the infection itself with those which are in the nature of various complications supervening upon the lesions from which the virus has escaped.

2. Citrated blood to which an antiseptic substance has been added may be preserved in a refrigerator at + 1° C. for at least three months without losing any of its useful qualities.

3. In no case should the dose employed be less than 1 cc. of blood per kgm. live body weight of the animal to be immunized, no matter what species it belongs to.

4. If the above conditions are complied with, the injection of citrated blood from recovered animals quite uniformly shows itself to be endowed with definite preventive qualities, which enable the inoculated animals to withstand successfully both natural infection and subcutaneous inoculation with massive doses of virus (virulent lymph, 1/20th cc. ; virulent blood, 5 or 10 cc.).

5. The duration of the immunity conferred upon the inoculated animals does not exceed a fortnight in the majority of cases. It may be prolonged corresponding lengths of time by administering a second or a third injection having regard to the same conditions as with the first injection.

6. The only animals that can be protected in this way are those which are still free from infection at the time of the injection. If the animals are inoculated during the incubation period the blood of recovered animals does not have the least effect in curtailing the progress of the disease, which, however, runs an apparently more benign course.

Although this method of blood inoculation is capable of giving such fruitful results, especially in keeping alive young subjects invariably, it is of limited value as compared with a method that would be capable of conferring upon the animals an immunity of longer duration. The experiments carried out by LÖFFLER, NOCARD, ROUX, and the authors, COSCO and AGUZZI, etc., are well known. The majority of them were attempts at sero-vaccination. In resuming their investigations, Vallée and Carré used the blood of recovered animals, associated with the virus of foot-and-mouth disease in various ways, in the form of the lymph or filtered macerated epithelium, or preserved defibrinated virulent blood.

It was found that one may inoculate with impunity cattle or sheep with doses of from 1–10 cc. of virulent blood when they are protected with the blood of recovered animals, and the virulent inoculation may be performed simultaneously or five days later than the preventive inoculation. Animals thus treated, and subsequently tested when the effects of the preventive dose of blood must have with certainty disappeared, were found to resist infection, either by contact with affected animals or by vesiculation. They were found able to emerge successfully from an outbreak, outside the laboratory, without contracting the disease.

Experiments are in progress with a view to establishing the duration of the immunity thus conferred and its value against virus obtained from animals of different breeds and used for various purposes, and also in order to find out whether it is preferable to carry out both inoculations simultaneously or successively. Vallée and Carré publish their results, which involve observations on some hundreds of animals, at this juncture in order to comply with the recommendations of the International Conference on Epizootics, which recently opened its sittings at Paris. [See preceding number of this *Bulletin*, p. 200.]

MISCELLANEOUS.

VELU. **Les anémies pernicieuses du cheval au Maroc et les diagnostics biologiques.** [The Pernicious Anaemias of the Horse in Morocco and Biological Methods of Diagnosis.]—*Rec. Méd. Vét.* 1921. June 30. Vol. 97. No. 12. pp. 263–267.*

The term " Fez disease " is applied to a group of diseased conditions affecting the horse in Morocco, all of which reveal very similar symptoms. FRAY (*Revue Vétérinaire Militaire*, 1913, pp. 479–480) gives the following as the most constant symptoms: " Sudden rise of temperature, petechiae on the conjunctiva, paralysis of the hind quarters, and sometimes a jaundiced tinge of the mucous membranes. The progress of the disease is slow, the affection being of a distinctly chronic type. The period of convalescence is long and relapses are both frequent and serious."

Clinical observations do not enable one to differentiate between the various pernicious anaemias included under the above name, for all show wasting, digestive disturbance, febrile attacks and muscular

* Abstracted by Mr. T. J. Bosworth, B.Sc., D.V.S.M., M.R.C.V.S.

weakness; but it is now known that the term "Fez disease" comprises at least four distinct diseases :—

(1) Trypanosomiasis of horses in Morocco (including dourine). (2) Piroplasmosis. (3) Spirochaetosis. (4) Filariasis.

A simple examination will, however, often lead to the identification of the causal organism. Thus, microscopical examination of a drop of fresh blood or oedematous fluid between a slide and cover-glass reveals the presence of filariae, spirochaetes or trypanosomes if made during a febrile crisis or when the parasites are present in sufficient numbers. Thin smears from the first drop of blood or serosity obtained, fixed and stained by Pappenheim's or Laveran's panchrome, will show the presence of piroplasms which appear in the rose-coloured corpuscles as dark violet masses of chromatin with a little sky-blue protoplasm, or in certain piroplasms surrounded merely by an uncoloured zone. Intraperitoneal inoculation of the dog with 100–200 cc. of citrated blood may be resorted to when trypanosomes or spirochaetes are suspected but are not present in sufficient numbers to detect under the microscope.

If the actual cause of the condition can be ascertained, then it is possible to apply rational treatment. There are, however, cases in which the etiology is obscure and further investigations are necessary. A record of systematic blood examinations in all cases would be of valuable assistance.

WRIGHT (Lewis H.). **Some Observations regarding Eosinophiles.**—*Jl. Agric. Res.* 1921. Aug. 1. Vol. 21. No. 9. pp. 677–688.

Until recently the presence of an unusually large number of eosinophiles in the blood was considered to be almost diagnostic of a severe infestation with some form of external or internal parasites, while on the other hand an absence of eosinophilia was held to present very strong evidence that the animal was almost, if not entirely, free from parasitic invasion. During the past few years, however, our knowledge regarding the relationship between parasitic infestation and an eosinophilia has been undergoing a considerable change. In this paper Wright, of the Nevada Agricultural Experiment Station, reports observations based on a study of 40 horses. From one to more than 20 blood examinations were made on the individual cases, some of which extended over a period of about 18 months. In all the cases the animals were carefully post-mortemed and a close search for internal parasites was made. None of the animals harboured external parasites. In the first table the blood-counts of 15 horses in apparent good health are given; 79 counts in all were made and the average count was as follows: haemoglobin 90·4, erythrocytes 7,783,300, leucocytes 7,693 (lymphocytes 34·8 per cent., polymorphonuclears 52·9 per cent., mononuclears 6·8 per cent., *eosinophiles 5·3 per cent.*, mast cells 6 per cent., transition cells 0).

The percentage of eosinophiles in the peripheral blood of these healthy horses varied greatly even when the examinations were made at frequent intervals (in one horse, for example, they varied from 0·2 to 11·2 per cent., and this maximum figure fell to 3·6 per cent. after an interval of 10 days). These exceedingly varying results may possibly account for the different conclusions arrived at by many writers regarding the percentages of eosinophiles in the blood of normal horses and horses suffering from various diseases.

The study of the blood in what appeared to be normal animals presents considerable difficulty, in that nearly all harbour numbers of parasites of various genera. Two of the apparently normal animals observed by Wright presented a very high percentage of eosinophiles. One animal which was examined nine times over a period of six months gave an average of 17·2 per cent. of eosinophiles ; and on post-mortem examination this animal showed a relatively small number of internal parasites. Another horse examined once showed 13 per cent., and on post-mortem there were found large numbers of internal parasites. These were the only two animals that showed an unusually large number of eosinophiles. At single examinations of some of the other horses, results exceeding this 13 per cent. figure were obtained.

In the second table figures are given concerning the blood-counts of eight horses in poor condition due to internal parasites. Nineteen counts were made, the average results were : haemoglobin 69·2 per cent., erythrocytes 5,822,000, leucocytes 8,363 (lymphocytes 33·1 per cent., polymorphonuclears 53·6 per cent., mononuclears 11·4 per cent., *eosinophiles 2·2 per cent.*, mast cells 0·08 per cent., transition cells 0).

In none of these cases is there a higher figure than 5·8 per cent. eosinophiles recorded. The post-mortem examinations revealed in nearly all a severe parasitic infestation. It would thus appear that the degree of eosinophilia gives no indication as to the intensity of the parasitism in horses.

Weinberg and Sequin (1914–15), however, have studied this question very fully and shown that the eosinophiles are specifically attracted towards certain toxic substances, especially those of parasitic origin. It may be, therefore, that the degree of eosinophilia is related somehow with the resisting power of the animal. If this is high the eosinophiles would be plentiful in the infested animals, while, on the other hand, if the resistance were low the eosinophiles would be few. In general it would seem that the physiological functions of the leucocytes are essentially the same in the various species of animals. If this be so, cattle must be ordinarily very severely infested with parasites, or else their resistance is high, for as has been shown by Dimmock and Thompson (1906) the average percentage of eosinophiles in the blood of normal cattle is 13·15. According to Burnett's tables the percentages of eosinophiles are about the same for all animals except cattle.

Hitherto the eosinophile content of the horse's blood has been used as a valuable aid in differentiating between infectious anaemia and anaemia due to parasitic invasion. The symptoms of the two diseases are very similar, but the absence of an eosinophilia and the presence of a recurrent high temperature have been taken to indicate infectious anaemia. In the horses used by Wright in the above estimations, however, transmission experiments failed, and therefore infectious anaemia could be definitely excluded. Again, in a few months all the horses which were assumed to be in poor condition due to internal parasites died or were killed ; seven were severely infested with Strongylus and Cylicostomum, and the eighth harboured an enormous number of bots. Moreover, when they were first examined the horses were in fair physical condition, and some, in fact, were in good condition. Their resistance, therefore, should have been good. The degree of eosinophilia did not, however, appear to bear any regular relationship with the progress of the affection although in most it appeared to decrease considerably.

In the third table the blood-counts of two horses, one that apparently died from infectious anaemia and another suffering acutely with septicaemia, are given. The average count was: haemoglobin 85 per cent., erythrocytes 7,325,400, leucocytes 6,693 (lymphocytes 33·2 per cent., polymorphonuclears 58·6 per cent., mononuclears 6·3 per cent., *eosinophiles 2 per cent.*, mast cells 0·02 per cent., transition cells 0). A moderate degree of parasitic invasion was found post-mortem in both these animals.

A series of counts are next given of horses suffering from acute, subacute, and chronic infectious anaemia. In the acute cases the figures were as follows:—8 horses, 19 counts, haemoglobin 73·6 per cent., erythrocytes 6,285,600, leucocytes 7,021 (lymphocytes 29·3 per cent., polymorphonuclears 58·1 per cent., mononuclears 5·4 per cent., *eosinophiles 2·5 per cent.*, mast cells 0·04 per cent., transition cells 3·3 per cent.).

It is to be noted, however, that transition cells were only detected in one horse which at two counts had given remarkably high percentages of 31·4 and 30 per cent. This was a four-year-old mare which on post-mortem revealed a few bots, one Setaria, and a small worm-free aneurism of the anterior mesentery artery, and an enormous infestation of the caecum and colon with Strongylus and Cylicostomum.

Nearly all these horses revealed a moderate or severe parasitic invasion post-mortem.

In the subacute cases (2 horses, 4 counts) the figures were: haemoglobin 73·8 per cent., erythrocytes 5,655,000, leucocytes 6,754 (lymphocytes 37·8 per cent., polymorphonuclears 54·9 per cent., mononuclears 6 per cent., *eosinophiles 1·2 per cent.*, mast cells 0·15 per cent., transition cells 0). One of these horses was moderately infested and the other seriously infested with worms.

In the chronic cases the figures were as follows:—7 horses, 53 counts, haemoglobin 84 per cent., erythrocytes 7,119,000, leucocytes 7,325 (lymphocytes 33·5 per cent., polymorphonuclears 56 per cent., mononuclears 7·3 per cent., *eosinophiles 2·9 per cent.*, mast cells 0·3 per cent., transition cells 0). These animals were all found to be infested with worms post-mortem, and the degree of invasion varied from slight to severe.

HADWEN (1918–20) (see this *Bulletin*, 1920, Vol. 8, p. 144) has maintained that the eosinophiles in infectious anaemia are diminished in number and sometimes absent from the peripheral blood. This disappearance of the eosinophiles was also noticed particularly in some of Wright's acute cases and in a few of the counts made from the chronic cases.

[It seems probable that Wright was also working in a district ordinarily heavily infested with worm parasites, so that the degree of infestation in his apparently normal horses is very likely unusually high.]

REPORTS.

BRITISH GUIANA. **Report of the Department of Science and Agriculture for the Year 1918.** [HARRISON (J. B.), Director.] Live Stock, p. 30; and Report of Government Veterinary Surgeon [MILNE (A. Seton)]. Appendix IV, pp. 63–64.—141 pp. F'cap. 1920. Georgetown, Demerara: "The Argosy" Co., Ltd., Government Printers.

The Agricultural Section gives the following figures for the year 1918:—Horses 1,602, mules 2,359, donkeys 5,332, cattle 107,108, buffaloes 176, goats 11,236, sheep 20,611, swine 12,582. There was a general decrease in the numbers of all kinds of stock except swine, which showed increase. There was a marked decrease in the number of milch cattle available for the milk supplies of Georgetown, of New Amsterdam, and of the principal villages. This was partly due to the fact that many East Indians who formerly made their living, or obtained assistance in doing so, by keeping cattle in the production of milk for sale now give their attention to rice planting, and also partly to the change of policy adopted by most proprietors of sugar estates, who now refuse to allow their managers to keep large herds of cattle. This restriction, although it may be in the interests of the estate proprietors, has taken away the incentive towards the improvement of live stock in the colony and done away with what were regarded as excellent object lessons to small farmers and cattle keepers in the economic maintenance of live stock. It is regretted that in the interests of the colony large proprietors of sugar estates do not themselves carry on a live stock industry as a subsidiary undertaking to their main one.

The Government Veterinary Surgeon reports that the colony is at present entirely free from epizootics. No case of glanders had been reported for two or three years, and it was anticipated that the colony would be before long free from anthrax and swine-fever. The live-stock at the Botanic Gardens appear to be in very good health and the importation of some good working stock is contemplated. Some pig, horse, and donkey breeding operations were carried on, and Government stock and police horses were also looked after.

MAURITIUS. **Annual Report of the Department of Agriculture for the Year 1920.** [TEMPANY (H. A.), Director of Agriculture.] Veterinary Division; Report of the Government Veterinary Surgeon. p. 11.—19 pp. F'cap. 1921. Port Louis: Acting Government Printer.

This report contains nothing of great interest. During 1920, 15,541 animals were imported, to the value of over one million rupees. These included Madagascar bullocks 9,931, goats 2,389, pigs 1,310, sheep 1,169, mules 258, horses 169, ponies 218, donkeys 4, dogs 6, cows and bulls (stud animals) 81, miscellaneous 10.

A number of dogs were examined on board different ships, but no landing was allowed, as the animals were not accompanied with the necessary certificates. A number of animals belonging to different Departments were attended to during the year. One herd of cattle which had been affected with surra was tested with negative results and released from quarantine. Three cases of this disease were detected, in two horses and one mule, and the affected animals were

slaughtered. No cases of epizootic lymphangitis or piroplasmosis occurred during the year. Animals on several estates were tested with tuberculin, these comprised 158 cows, heifers, and bulls; 20 reacted to the test and were slaughtered. Twenty-three cows and bulls imported from Australia were tested on landing, as they were not accompanied with certificate relating to freedom from the disease. One cow reacted and disclosed lesions post-mortem. Cases of illegal slaughtering of immature animals occurred and the owners were prosecuted, but 44 cattle under age were allowed to be slaughtered as they were sterile, affected with incurable diseases, or accidentally injured.

A number of interesting breeding experiments were carried out on the Stock Farm with Jersey, Normandy, and Holstein-Afrikander and Indian cattle.

EGYPT. **Ministry of Agriculture. Veterinary Service. Annual Report for the Year 1919–20.** [LITTLEWOOD (W. L.), Director.]—47 pp. 1921. Cairo: Government Press. [Price PT. 5.]

SECTION ON CONTAGIOUS DISEASES.

Cattle Plague (*Rinderpest*). During the year, 1,794 deaths were reported in two Governates and 14 Provinces. This represented a death-rate of about 0·1 per cent. In addition to the cases that occurred in the interior of the country, 621 cases were detected amongst cattle imported from the Sudan. The number of cattle (actively) immunized during the year was 46,110, with 171 deaths following upon the "double" inoculation. Of this number 4,964 cattle were inoculated against payment at the request of the owners. Several tests were made with virulent blood upon the cattle of the State domains which had been immunized, and results were found to be excellent. In one experiment the immunity was found to have lasted for six years and four months.

Arrangements were made to reopen the Serum Institute at Abbasiya from April 1st, 1919, for the manufacture of anti-rinderpest serum. On account of difficulties in obtaining the necessary equipment and in erecting and repairing the buildings required, the Institute could not be placed in working order until the end of August, 1919. In June, 1919, owing to the insufficient supply of Indian serum, 20,000 doses (50 cc.) were ordered from the Serum Institute at Nairobi, British East Africa. This serum was tested at the Serum Institute and it was found to be weaker than the Egyptian serum. It was hence found necessary to increase the dose by 50 per cent. In order to meet the Egyptian requirements it was found necessary to keep 150 serum-producing bulls at the Institute, and the output of serum is still regarded as inadequate, and it is therefore necessary to increase the number up to 200 bulls. The Budget for the Institute for the Financial Year was estimated at £E.27,450.

An account is given of the equipment and administration of the Institute. The daily ration for the serum bulls is: beans, crushed, 1 kgm.; maize, crushed, 1 kgm.; linseed cake 2 kgm.; *tibn* 6 kilos; *drees* 2 kgm. *Drees* is substituted by *bersim* and green *dura* when possible, the ration being 1 kgm. of *drees* to 7½ kgm. of green fodder. Rock salt is always supplied. The best type of Egyptian bulls is purchased whenever possible (average price £E.45), and 189 bulls have been purchased, together with 13 Cyprus bullocks, which have been hyperimmunized.

Out of the total number, 202, there remained 158 on March 31st. This shows a total loss of 44 animals (21·7 per cent.). These heavy losses were unavoidable, inasmuch as the animals had to be bought and hyperimmunized very quickly. The losses were: deaths 32, bled to death for serum 8, stolen 4. The causes of death were as follows: anaphylaxis (or purpuric condition following re-enforcing) 14, Texas fever 8, toxaemia 4, gastro-enteritis 2, cattle plague 1, heart failure 1, ruptured aorta 1. Animals bled to death for serum suffered from chronic debility following Texas fever 3, chronic lameness 2, tuberculosis 2, tuberculosis and cysticercosis 1. Anaphylaxis, which caused great losses in the previously established Serum Institute, gave rise to nearly half the deaths recorded.

Forty-five cases of Texas fever were diagnosed in the serum cattle or in those which are still being immunized. Of the 8 fatal cases 2 occurred in bulls which had been doubly inoculated and which had never been re-enforced, while 1 of the remaining 6 was in a serum-producing Cyprus ox. Arrhenal is stated to have been largely used in the treatment of the disease and to have given good results. Only one Egyptian animal died after the first double inoculation, and this animal had been inoculated with British East African serum, dose 100 cc. Eight hundred and forty-eight separate re-enforcements were carried out, four litres of virulent cattle plague blood being given at each injection. One thousand six hundred and thirty-two bleedings were performed, giving a total of 6,712 litres of blood.

As in previous years, Cyprus cattle were imported for the production of virulent blood (294 were imported). They were generally of good quality, but there was some difficulty in obtaining regular supplies. A total of 34 cases of Texas fever was diagnosed in these Cyprus cattle, and 60 cases of Egyptian fever. The greatest care was taken to ensure that virulent blood issued to the Provinces was free from Texas fever. The Cyprus cattle were inoculated with about 2 cc. of virulent blood, as required, and bled to death from the carotid artery on the sixth day after inoculation. The blood was examined microscopically on the fourth, fifth and sixth days after inoculation, and no blood showing redwater piroplasms was issued. The percentage yield of serum, after centrifugation and addition of preservative, varied from 47·6 in October, which was very hot, to 36·8 per cent. in the cold month of February. The serum bottles utilized were of about 220 cc. capacity. The minimum safe dose of serum for Cyprus cattle was found on testing to be 20 cc. per 100 kgm. body weight, but in one case 15 cc. saved the cattle in the test. Taking the susceptibility of Egyptian cattle as half that of the Cyprus cattle, the safe dose for large Egyptian cattle averaging about 500 kgm. weight was fixed at 100 cc. per head. A test was also carried out on three Cyprus cattle with serum taken from a lot of six bulls which had only been re-enforced twice and were bled about six weeks after the last re-enforcement. The test showed that although the serum was efficient it was not strong enough to use alone in the same dose as the mixed serum.

Rabies.—During the year, 64 cases were reported in three Governates and 13 Provinces amongst animals (59 dogs, 3 calves, and 2 wolves). Nearly 2,950 dogs were seized in Cairo during the year, and, in addition, 3,386 dogs and 5,815 cats were destroyed in Cairo and its suburbs. In all outbreaks of rabies, and in every suspicious case, a certain number of dogs in the village were destroyed in order to prevent the disease extending. Hence in the Mudiriyas and Governates (excluding Cairo and Alexandria), 43,352 dogs and cats were poisoned.

Glanders.—One hundred and six cases of glanders were detected in three Governates and five Provinces, and 4,284 animals were tested with mallein.

Epizootic Lymphangitis.—Seven cases were reported, viz., six in the Cairo Governate and one in the Sharqiya Province. Treatment with novarsenobenzol gave satisfactory results.

Anthrax.—Nine cases reported.

Sheep-pox. Number of cases reported 334, chiefly in quarantine stations among imported Sudanese sheep.

Foot-and-mouth Disease.—Forty cases reported.

Haemorrhagic Septicaemia.—One hundred and thirty-five cases in cattle and buffaloes reported. Preventive treatment by serum inoculation was adopted in several outbreaks. The animals thus treated with satisfactory results numbered 4,222. In addition, 13 cases were detected in equines.

Mange.—Cases reported numbered 167, in two Governates and five Provinces. The number of camels treated for mange against payment during the year was 1,340.

Strangles.—Sixty cases reported during the year, in one Governate and six Provinces.

Spirochaetosis in Fowls.—No cases reported.

Trypanosomiasis.—One case only was reported, in a camel in Beheira Province associated with filariasis.

Piroplasmosis in Egyptian Animals.—One hundred and seventy-seven cases were detected in cattle, in one Governate and 12 Provinces. including 28 animals imported from Cyprus. Of these, 57 died or were slaughtered and 120 recovered. Arrhenal is said to have given satisfactory results in treatment and the use of this product is contemplated on a larger scale. The number of animals sprayed for the destruction of ticks against payment was 838.

Piroplasmosis in Soudanese Animals.—Thirty-five cases were reported in cattle and sheep in the quarantine pens. All died or were slaughtered.

Tuberculosis.—Cases reported numbered 3,108, the great majority of these being in the Cairo and Alexandria abattoirs.

Tetanus.—Twenty cases were reported in three Governates and 10 Provinces.

Coccidiosis.—Fifty-four cases were detected, viz., 53 in Sudanese sheep in the Shellal and Cairo quarantine pens and one in a bull.

Contagious Bovine Pleuro-pneumonia.—Forty-four cases were detected, all in animals imported from the Sudan.

Stiff Sickness.—Cases reported numbered 346, in one Governate and 11 Provinces.

Bursati.—Three cases were reported, viz., two in horses and one in a donkey.

Cowpox.—One case only was detected in a buffalo.

Camel-pox.—One case was detected.

Horse-pox.—One case was detected in a mule.

Fowl Plague.—Cases reported numbered 156 in one Governate and three Provinces.

Fowl Cholera.—Two cases were reported.

Actinomycosis.—One case only was detected.

Malta Fever.—One case was detected in a goat.

Swine Plague.—Thirty-five cases were reported, mostly in the Canal Governate.

Swine Fever.—Three cases were detected in the Cairo quarantine pens.

Malignant Oedema.—Seven cases were reported in two Provinces.

There passed through the Shellal quarantine station, 25,900 cattle, 143,830 sheep, 55 horses, mules and donkeys, 207 camels, 137,543 hides and 124,839 skins, and, in addition, there were imported from the Sudan, via Suez, 2,555 cattle, 9,111 sheep and goats, 30 horses, donkeys and mules, 241 hides and 410 skins.

Besides these animals imported from the Sudan, there were imported into Egypt during the year 457 cattle and buffaloes, 355 horses, mules and donkeys, 27,998 sheep and goats, 3,570 pigs, etc., and 11,426 camels.

Figures are given concerning the Isolation Hospital for Contagious Diseases of Animals at Abbasiya. In 1919 there were 505,150 cattle and 539,741 buffaloes in the country. This shows a decrease of 11,610 cattle and 31,365 buffaloes as compared with 1918. A census also showed 31,192 horses, 21,890 mules, 576,141 donkeys, 117,678 camels, 21,331 pigs, 858,107 sheep, and 325,854 goats.

The slaughterhouse returns for the year are also given.

No frozen meat was imported by the two British firms during the year, as all Australian frozen meat was purchased by the British Government, as in the previous year.

Figures are given concerning the veterinary legal cases undertaken.

VETERINARY PATHOLOGICAL LABORATORY. [MASON (F. E.) Veterinary Pathologist.]

A total of 1,675 specimens was examined at the laboratory, a number of which appeared to have been of considerable interest. A rough summary is also given of a series of investigations that were carried out. It is stated that bursati, which is regarded as a disease of equines caused by a specific fungus, is not simply a skin affection, as hitherto described by all writers, but that characteristic lung lesions caused by the same fungus are constant. The conclusion arrived at is that infection takes place primarily in the lungs, probably by the inhalation of spores and that the skin lesions develop when the external atmospheric conditions are suitable for the growth of the organism on the surface of the body. This is held to account for the seasonal recurrence of the skin lesions year after year in the same subject. Incidentally it was discovered that "summer sore" (*Dermatitis verminosa*), which is considered to be a skin disease of equines caused by filarial embryos (*Filaria irritans*), also exists in Egypt. The condition is said to resemble the skin lesions of bursati so closely that differential diagnosis is uncertain without recourse to microscopic examination.

Experiments on cattle plague were continued, but are not yet completed. Immunity tests were continued on cattle that had been protected against cattle plague by the so-called "double" inoculation. Fifteen bulls that had been immunized six years and four months previously proved resistant to inoculation with 5 cc. of virulent blood and showed no evidence of reaction.

Experiments were continued upon the curative treatment of epizootic lymphangitis by means of novarsenobenzol. The results are stated

to confirm those of previous experiments. Good results are claimed to have been obtained provided the subjects were not advanced in age. A new hydatid was discovered in the camel and named *Cysticercus cameli.*

SCHOOL OF VETERINARY MEDICINE. [MASON (H.), Director.]

Owing to the transfer of the School at Giza and to the establishment of a proper infirmary in the vicinity of the School premises, greater facilities were obtained for the practical teaching of students. The former Director, RABAGLIATA (D. S.) was transferred as Director of the Serum Institute. In April, 1919, there were 27 students in the School (1st year 10, 2nd year 7, 3rd year 8, 4th year 2). The number of students is regarded as unsatisfactory, and their attendance appears to have been irregular. The unsatisfactory number is due to the fact that although the standard of the entering certificate was raised to the Secondary instead of the Primary Certificate since 1914, and the School placed on the same footing as other high schools, the recognition of the School as a high one has not yet been finally decided upon.

MOROCCO. **Rapport du Vétérinaire Major de 2ème Classe Velu sur le Fonctionnement du Laboratoire de Recherches pendant l'année 1920.** MS. received 27th April 1921. 11 pp. F'cap. With 3 circulars attached.

In this report Velu gives a brief account of the organization of his laboratory at Casablanca, and the methods which he has instituted in order to control and obtain further knowledge on the subject of contagious disease of stock in Morocco. During the course of the last few years this author has contributed a considerable number of valuable articles on tropical diseases to the literature, in spite of the fact that his laboratory facilities appear to have been strictly limited. In 1920 the research laboratory was, however, reorganized so as to permit of an increase in its activity, and it is hoped that when the plans outlined in 1914 for the reconstruction of the Experiment Station will have been completed, the service, of which the author is the Director, will be capable of rendering great assistance to the stock-breeding industry of the country. Hitherto the laboratory has directed its activity to the following purposes:—

1. Laboratory diagnosis of material received. In this connection an attached circular addressed to veterinary inspectors states precisely the manner in which virulent material destined for the laboratory is to be collected and transported, and in a table is shown the diseases or disease symptoms in connection with which the laboratory should be consulted, the samples to be made and forwarded, what the laboratory is capable of doing therewith, and the information it can supply thereon.

2. The distribution of sera and vaccines and, in particular, those used in connection with vaccination against anthrax, blackquarter, and sheep-pox, details concerning which are given in two of the attached circulars.

3. Application of modern recognized methods to the study of the principal problems concerning animal disease in Morocco, viz., investigation regarding the causes of the most widespread diseases of the country, conditions which favour their appearance, and the measures for dealing with them. Special reports have been published from time to time in this connection.

The technical personnel of the laboratory is considered to be sufficient, and comprises two veterinary and two laboratory assistants, together with four natives. The present laboratory is quite inadequate, and, in the circumstances, it would be absolutely impossible to combat a disease such as rinderpest if it were imported into Morocco. Moreover, small laboratory animals cannot be bred on account of the impossibility of disinfection. Pigeons die of fowl cholera, guinea-pigs of a plague, rabbits of coccidiosis, mange, etc.

In order to assist stockowners by means of laboratory diagnosis, the necessary material for obtaining samples, together with instructions are now distributed to all officers in the public service, and to the chief breeders, so that in the event of an outbreak the essential condition of having material forwarded immediately for diagnosis may be complied with.

With regard to the distribution of sera and vaccine, which rose to well over 100,000 doses in 1920, a few complaints were received from some owners with regard to the quality of the products, but most of these were found to be groundless. There was one important exception, however, namely, with regard to the transient effects of vaccination against anthrax and the inefficacy of serum against the disease.

The exportation of sheep from Morocco has hitherto been greatly restricted owing to the numerous difficulties encountered by sheep owners, and, in particular, they have been compelled to keep their animals for a month after sale in order to have them vaccinated against sheep-pox. The hiring of grazing ground during this period is often very costly, and in the meantime the sheep lose condition considerably, and it is often very difficult to arrange subsequently for their transportation by sea. Velu asserts that in order to overcome this difficulty completely sheep-pox vaccination should be carried out at the owner's place, for they can then be exported to France, where they would always obtain a very ready market if they have been treated previously within a year. The best time for vaccinating is during the winter, and the material can be obtained for a very small sum from the laboratory (0.28 fr. per dose, official mark 0.12 fr., and veterinary fee 0.20 fr. per head).

With regard to investigation work, the following were the principal subjects that received notice :—

The Trypanosomiasis of Horses in Morocco.—Researches have been carried out on this subject since 1914, and studies in connection with the identification of the trypanosome have been resumed in collaboration with Bouin. A number of the author's studies on the trypanosome (which he calls *T. marocanum*) have been summarized in this *Bulletin*. Attempts at treatment with an arsenical drug called "osarsan" have been encouraging, and appear to be on the point of furnishing useful results.

Dourine.—The treatment of this trypanosomiasis is likewise under control, and it has been found in this affection again that the drug treatment requires, in order to be effective, the employment of at least two trypanocidal products.

Infectious Anaemia of the Horse.—The so-called "Fez" disease (*Maladie de Fez*) has been still further dismembered, for it is now found to comprise, besides trypanosomiasis, spirillosis, piroplasmosis, and microfilariasis—still another infection manifested by the same

clinical syndrome. This newly-discovered condition is said to be an infectious anaemia which is generally curable. Researches are being undertaken upon it in conjunction with BIGOT and BALOZET.

Anthrax.—The author's experiments have resulted in a simplified method of vaccination, and it was found that in Morocco immunization might be commenced with the injection of the 2nd Pasteur vaccine. In the circular it is, moreover, stated that on account of the high degree of virulence attained by this disease in Morocco it is absolutely necessary to vaccinate herds against it twice annually, first with the 2nd Pasteur vaccine, and then secondly, 12 days afterwards, with a special strong vaccine prepared by the Casablanca Laboratory. In the affected districts, especially Gharb, Chaouïa and Mzab, deaths occur in all herds with the advent of the hot season, and then take place continuously in the form of an irregularly progressive epizootic. In these circumstances sero-vaccination is indicated, but is laborious and rather costly. However, it is recommended that in all infected districts, that is to say, districts in which the disease has appeared during preceding years, preventive vaccination should be undertaken as a routine measure, and the time when it is best carried out is from the commencement of the rains up to the end of March. It would appear, moreover, from tests made in Morocco, that the serum is wholly inefficacious. [For further details see this *Bulletin*, 1920, Vol. 8. p. 141.]

Pneumo-enteritis of the Pig.—Studies in connection with pig diseases of this type have been continued [see this *Bulletin*, 1920, Vol. 6, p. 126]. Anti-fowl cholera serum would appear to have given good results in an outbreak of Pasteurellosis among pigs [see this *Bulletin*, 1920, Vol. 8, p. 322].

Fowl Cholera.—Experience gathered in a number of outbreaks in this disease would appear to indicate that it is possible to combat the disease by means of serum alone without resorting to vaccination. Serum was prepared in the laboratory, and by its means it was possible to cut short a number of severe outbreaks. Special attention, it would seem, has to be directed towards the manufacture of the serum.

Foot-and-Mouth Disease.—The principal lesions, and the value of cardiac tonics in treatment, were studied in the course of an outbreak [see this *Bulletin*, 1921, Vol. 9, p. 113].

Cerebro-spinal Meningitis.—Two cases of this condition in goats were studied. Attempts at serum treatment were ineffective.

Parasites and Parasitic Infections.—Numerous observations were made in this connection, and the use of arsenical baths in the treatment of mange was specially studied.

Several cases of echinococcus infestation of the heart were observed [see *supra* p. 232].

Miscellaneous Studies.—These were made in connection with (1) pyo-bacillosis of the pig, its etiology, characters of the causal agent, and treatment by means of pyo-therapy; (2) pseudo-tuberculosis of the pig, and the method of carrying out the intrapalpebral test in this animal; (3) the feeding value of fish meal, and (4) the surgical treatment of inguinal hernia in young pigs.

Instruction courses were also given to veterinary surgeons recently arrived in Morocco.

NIGERIA, Northern Provinces. **Annual Report of the Veterinary Department for the Year 1920.** [BRANDT (F. R.), Chief Veterinary Officer.]—11 pp. F'cap. Lagos: Government Printer.

The staff, comprising altogether three veterinary officers, appeared to have been engaged chiefly in tours of inspection and instruction of native stock inspectors and advising owners and native officials.

Northern Zaria, part of Southern Kano and Sokoto were the only Provinces which could be attended to during the year by veterinary officers. As a result of these tours, numerous outbreaks of disease were detected which had not been reported. The Fulani cattle owners are now not so apprehensive towards veterinary officers as they were a few years ago, and with the increase of veterinary staff it is hoped that the Department will shortly be in a position to acquire detailed knowledge of existing disease and combat outbreaks by inoculation measures, provided the native administration can exert an efficient control on diseased herds. There are now 44 native stock inspectors who have received an elementary training on live stock and contagious diseases, and appear to be of some use when working under the supervision of a veterinary officer.

A meeting of Headmen of all the Zaria districts was called for the first time in 1920, and 88 outbreaks of disease in this Province were subsequently notified. The natives exhibit extraordinary reticence with regard to the incidence of disease in their herds, and disease thus spreads to a considerable extent among cattle, especially as the result of trading. The regulations in connection with the control of disease, such as reporting, quarantine, and restriction of movement, are supposed to be enforced by the native administration, but the difficulties in carrying out these regulations are very great, and some years will elapse before they can be enforced generally. However, unless some steps are taken to initiate them, technical measures such as inoculation will be largely useless. Leaflets concerning animal disease are now printed in the Hausa language and circulated.

A scheme was submitted in February for the organization of a veterinary department sufficient to deal with the live stock problems of Nigeria. This scheme comprised administration and field staff, laboratory, experimental stock farm, and education of natives. The project was apparently approved by the Governor-General, but it was considered that the organization should be built up gradually and a commencement made on a small scale, especially with regard to the field staff. The live stock of Northern Nigeria numbers about 2½ million cattle, over two million sheep, nearly four million goats, over 130,000 horses, and over 250,000 donkeys, the total value of which is at least £20,000,000. The great problems connected with this valuable asset will only be solved by an adequate veterinary organization, and what is regarded as the keynote to the control and eradication of disease, viz., an effective police organization for enforcing measures of segregation by the native administration. The improvement and control of disease in cattle of the Northern Provinces, consisting for the most part of herds owned by nomads or semi-nomads accustomed for generations to wander uncontrolled throughout the country, and so suspicious and conservative as to avoid, whenever possible, any dealings with Europeans in connection with their animals, will obviously be a very gradual process. During the year a memorandum was received from the Secretary of State for the Colonies to the effect that the Veterinary

Department, which had hitherto been regarded as a branch of the Agricultural Department, should be a separate and distinct department.

In the Northern Provinces the connection between agriculture and live stock is very slight, for, as previously stated, by far the greater number of the cattle are wandering for most of the year. In some hamlets a few head of cattle are kept continuously, chiefly for purposes of providing milk and manure, but generally cattle are absent from the farms and villages for the whole of the year, except for a short period after the crops are gathered, when they are kept on the stubble for manure purposes. An endeavour should be made to induce the farmer to own and keep a few head of cattle on or near his farm, but the average Hausa farmer takes little or no interest in cattle and considers them to be the concern of the Fulani so much that he pays the latter to run his cattle on his farm for manure. As the Veterinary Department has a good opportunity of gaining a knowledge of live stock therefore it is proposed to establish experimental farms for the improvement of live stock.

Cattle Breeding.—The Fulani cattle owners have from time immemorial followed primitive methods, but there is no doubt that with regard to the herding and handling of cattle they are exceedingly capable. No particular attention, however, is paid with regard to the selection of bulls for breeding purposes and the strongest usually sire most of the calves. Improvements are badly needed, as evidenced by the low birth-rate and the large number which die young. The milk yield is exceedingly low and no provision is made for the conservation of fodder for young stock. Owing to the nomadic habits of the Fulani forage conservation is impracticable, but cultivation of fodder crops and conservation of grass should be adopted in the case of the comparatively few herds owned by the farmers. An experimental stock farm will prove of great value for discovering the peculiar characteristics of Nigerian live stock.

Diseases of Cattle.—Rinderpest.—For the first few months of the year the epizootic which commenced in 1919 continued, especially in Sokoto and Kontagora Provinces, and with the return of the nomad cattle from their dry season grazing grounds in Southern Zaria and Nassarawa some of the herds in the Bauchi Province, which had escaped the disease through the segregation of healthy herds in 1919, became affected. During the latter part of the year the disease began to assume an enzootic form with varying mortality. The history of the disease in Nigeria since 1914 is that after the severe epizootic of that year it existed in an enzootic form for about five years, that is to say, until the majority of the cattle, viz., those born during this period of five years, again became susceptible, when another epizootic occurred. There are therefore at present (*a*) some herds in which the disease has died out, and in which the number of susceptible animals will increase yearly, and (*b*) some herds in which it smoulders on and which remain enzootic foci. It may be argued that after a few years, when there is a large proportion of susceptible cattle, the likelihood that an epizootic will then occur will be quite as great owing to the persistence of these enzootic foci. It is, however, probable that a strain of increased virulence has been introduced from outside the Protectorate towards the north or north-east of Bornu Province, since this is the direction from which epizootics have spread. Calves under six months old, which after inoculation with virulent blood and anti-serum had shown a reaction, were observed at later periods

of life to contract a natural attack of rinderpest. Brandt, therefore, considers it not unlikely that a certain degree of resistance to the disease exists in calves born of immune cows immediately after an outbreak, and that at later periods in their lives this resistance is lost (this *Bulletin*, CROVERI, 1919, Vol. 7, p. 95). The general employment of inoculation measures is not recommended until thorough tests have been made as to its efficacy, for unless the nomadic stock-owners are convinced that its first general employment is successful they will do all they can to avoid it. Again, unless diseased and suspected herds can be effectually segregated inoculation with serum alone will result in an enormous wastage of serum. The conferment of active immunity entails a risk of introducing trypanosomes and probably other organisms in the virulent blood unless tested laboratory animals are available.

Contagious Bovine Pleuro-pneumonia.—As in 1919 numerous cases were discovered and the disease appears to be very prevalent. The apparently recovered animal is the chief means of spreading the disease, as these animals are sold by the owners and taken to healthy herds. It is extremely difficult to learn of this disease in a herd until infection has spread considerably. The natives have a method of inoculation which has been practised for generations, and although many deaths arise from the inoculation itself the practice should not be discouraged until inoculation with aseptic material under moderately aseptic conditions can be carried out. The general rule is to segregate herds for a period of six months, but in some cases this is found to be impracticable on account of the shortage of feeding and water, and it is left to the discretion of the veterinary officer in charge to release the herd provided the owners agree to have all suspected animals slaughtered.

Trypanosomiasis.—At the meeting of District Headmen referred to above the necessity was explained of reporting not only the diseases regarded as serious by the natives, for it is seldom that natives consider a disease to be serious unless it takes the form of a raging plague, but of all diseases. Numerous outbreaks of diseases known by various native names were found on investigation to be trypanosomiasis, due to *T. congolense* or *T. vivax* types. The herds affected had for the most part returned from their dry season grazing grounds in Southern Zaria and Nassarawa Provinces, in which parts they probably contracted the disease, but in many instances the disease appeared in local herds. During the rainy season the tsetse fly undoubtedly spreads northwards along the water courses, and sleeping sickness is said to be prevalent in the human subject on the River Gulma, north-east of Zaria. Biting flies, such as Stomoxys, Haematopota, and Tabanidae, which are very numerous in Zaria Province, act as mechanical carriers of the disease. With the opening up of trade and the employment of pack animals, it is not unlikely that trypanosomiasis will increase. Up to the present the known percentage of deaths is not high, but the available statistics from Zaria, part of Bauchi and a small part of Southern Kano comprise only a small proportion of outbreaks and mortality, and therefore even in Northern Nigeria trypanosomiasis is accountable for a very appreciable economic loss.

Foot-and-Mouth Disease.—Outbreaks were reported, but as the disease resulted in a low death-rate it was probably only very occasionally reported.

Haemorrhagic Septicaemia (in Cattle).—Outbreaks were discovered in Sokoto and Kano.

Contagious Impetigo.—This skin affection has for years been prevalent among cattle in Northern Nigeria. Although it is not frequently fatal it causes a great loss of condition. Microscopic examination reveals the presence of an organism similar to that described as causing the disease known under this name in Rhodesia (HORNBY, this *Bulletin*, 1920, Vol. 8, p. 232).

Anthrax.—Reports of suspected anthrax were received from outlying parts of the Protectorate, but in all cases in which blood smears were received no organism resembling the anthrax bacillus could be demonstrated microscopically. The Government of the United States of America now require with every imported cargo of hides a certificate that anthrax is not prevalent in the countries from which the hides originated. Such a certificate would imply that an effective veterinary organization exists in the country from which the hides were exported and also that the hides originated in the country from which they were shipped. So far as present knowledge regarding disease in Nigeria and adjoining French territory is concerned, such a certificate cannot be confidently granted. The United States of America, however, do allow hides to be imported without a certificate, provided they are, on arrival in America, submitted to some process.

Other Diseases.—Information was received of the existence of several diseases under native names. While no definite cases of tick-borne disease came to notice, it is not unlikely that in most parts of Africa diseases of this character are prevalent, but that on account of the immunity acquired during attack as young calves they are practically unrecognized.

Diseases of Horses.—Several cases of trypanosomiasis occurred, some of which yielded to arsenical treatment or recovered naturally. However, there was no opportunity to carry out reliable experiments.

Epizootic lymphangitis is a very common disease, especially in horses owned by natives, and in some cases it results in spontaneous recovery.

No serious outbreak of disease among sheep came to the notice of the Veterinary Department.

According to the Statistical Returns the numbers of cattle in Northern Nigeria appear to have decreased very considerably during the last two years, the figures being for 1918—3,533,473, 1919—2,945,290, 1920—2,394,888. Apart from the loss of cattle by disease, there is an increasing exodus of cattle to Southern Rhodesia for slaughter purposes. This is regarded as a normal and healthy sign of trade which should be encouraged provided it applies to adult cattle only. Again pleuro-pneumonia and trypanosomiasis took a considerable annual toll. However, the rinderpest epizootic, which was introduced early in 1919, was the chief factor in this very great economic loss, since, in addition to causing deaths, it had an adverse effect on the birth-rate. The significant decrease in the numbers of cattle points to the urgent necessity of an adequate veterinary department and machinery for effecting control of diseased herds.

SOUTHERN RHODESIA. **Report of the Chief Veterinary Surgeon** [SINCLAIR (J. M.)] **for the Year 1920, with the Report of the Veterinary Bacteriologist** [BEVAN (Ll. E. W.)]. 18 pp. F'cap. 1921. Salisbury, Rhodesia: Government Printer.

East Coast Fever (*African Coast Fever*).—Fourteen new centres of infection are reported. In reality, however, there were only three

fresh outbreaks due to unknown or unsuspected origin, viz., (1) at Quagga's Hoek, in the Melsetter district; (2) the Matopo Hills west of the Malundi River and adjoining farms; and (3) Sauerdale, in the Matobo district. The total mortality was 765, as compared with eight fresh outbreaks and mortality of 798 during the preceding year. Whilst the number of cattle and the extent of the areas involved were greater than in the preceding year, due entirely to the extensive spread of infection in the Matopos before discovery, the position generally is claimed to have improved considerably inasmuch as the disease was in evidence in three districts only, as compared with five in 1919. In the Melsetter district there were five farms in quarantine at the beginning of the year, but subsequently four were released as no case of the disease had occurred therein for 15 months. A serious outbreak, however, occurred in January at the farm Tarka, forming part of the Tilbury estate, on an adjoining part of which an outbreak had occurred in March, 1919. Both these outbreaks are traced back to some deaths which occurred in this area towards the end of 1918. An outbreak occurred in December on the farm Quagga's Hoek in the northern section of the district 30 miles in direct line from Tilbury, and it was found impossible to account for the origin of this infection, although in 1915 a severe outbreak had occurred on this farm. In the Gwelo district the mortality at a single centre persisted until June, viz., a period of 13 months after the discovery of the disease. In the Mazoe district mortality persisted at the original centre of infection until March, a period of 10 months from the commencement of the outbreak, and during the year the disease was discovered on three adjoining farms; the degree of infection, however, was mild and the mortality relatively small. In the Umtali district there was one infected centre at the beginning of the year, viz., at a farm (N'odzi), where a solitary case had occurred in December, 1919; no further suspicious cases occurred during the year. In the Victoria district there was one infected centre at the beginning of the year, viz., upon a farm (Morgenster), where the last death had been recorded in February, 1919; all restrictions were removed at the end of May. After seven years of freedom from the disease in Matabeleland, two outbreaks occurred in the Matobo district, the first amongst native cattle in the Matopo Hills in January, and the second in one of the subdivisions of Sauerdale in June. In the former a fairly large area was found to be involved when the disease was detected, and failure to suspect it earlier was largely due to the co-incident prevalence of blackquarter. Considering the extent of the area, the large numbers of cattle on it and in the vicinity, it was surprising that the infection had not spread to a much greater extent. At the Sauerdale centre infection was restricted to one herd on a well-defined area. There was no definite information as to the source of infection in either case.

The Cattle Cleansing Ordinance of 1918 was applied on September 17th, 1920, over a still larger portion of the territory. During the present year it is hoped to extend its operations further and soon to have no portions of the country inhabited by an appreciable number of cattle exempt from effective and regular dipping.

An attached schedule gives the following aggregate figures:—

Farms occupied by Europeans and natives: Farms 2,696; tanks 1,443. Cattle dipped: European 796,608, native 158,526; undipped: European 6,602, native 37,277.

Reserves and unsurveyed land: Tanks, 196. Cattle dipped: European 2,942, native 343,939; undipped: European 370, native 71,415. According to these figures the total number of cattle in the territory would be—European 806,522, native 611,137.

The total number of cattle dipping tanks is also 1,639, which is 294 more than in 1919, With regard to the idea of having a tank on every farm, the Melsetter district comes nearest, with 101 occupied farms possessing 103 tanks; however, it is noted that there were as many as six tanks on one farm. Great difficulty was experienced in obtaining material and labour for the erection of these tanks, otherwise a larger number would have been completed. It is noted that more European owned cattle were dipped in 1920 than existed in the country in 1919. It is not believed that all the cattle are being dipped regularly every seven days in accordance with the provisions of the Cattle Cleansing Ordinance, although probably the great majority are being thus treated; owing to the insufficient number of tanks, cattle have often to be travelled a long distance, and hence a minority is not strictly conforming to the regulations. It is surprising to find such a number of native-owned cattle on reserves and uninhabited land being dipped. It is estimated that on farms an average of 660 cattle is dipped at each tank. On native reserves the average is about 1,700 head. There is a considerable divergence in the number dipped per tank in the various districts. In the Melsetter district one tank serves an average of 212 cattle, whereas in the Chibi district a tank serves for 3,200 head. In the Charter district there is only one tank to every four farms.

Tuberculosis.—The pure bred herd of shorthorn cattle on the British South Africa Company's Shangani estate was submitted to the tuberculin test, as the disease had been diagnosed in two young bulls purchased from this estate. Thirty-five out of the 300 animals were found to be infected and 19 were regarded as suspicious. The affected ones included a number of valuable cows and bulls. Steps are being taken to eradicate the disease, and all cattle sold out of the herd in 1919 and 1920, prior to the discovery of the disease, are being subjected to the tuberculin test. The actual source of the disease could not be traced, but there is little doubt that it was conveyed to the herd by some heifers purchased in the Union of South Africa. Cattle imported into Rhodesia from overseas have been tested on arrival, whereas those from the Union have so far been exempt from the disease. This is only the second occasion in the history of Southern Rhodesia that tuberculosis has been diagnosed in a herd of well-bred cattle.

Since 1916 upwards of 88,000 head of cattle from Southern Rhodesia have been slaughtered at the Johannesburg abattoirs, and only 30 cases of tuberculosis detected amongst them.

Blackquarter (*Quarter Evil*).—This was the cause of considerable mortality in nearly every district. It would appear that fewer adult cattle were infected, and where the infection had been established for some years the seasonal mortality showed a marked decrease. Of the newer vaccines the filtrate, aggressin, and Leclainche and Vallée's vaccines have been largely used, and the last-named is said to have given most satisfactory results.

Anthrax.—Seven fresh outbreaks of anthrax occurred, with a mortality of 18 head, as compared with 4 and 105, respectively, during the previous year. Vaccination of in-contacts by means of Pasteur's double vaccine was largely resorted to, with strikingly beneficial results.

Contagious Abortion was detected in 36 herds in which its previous existence had not been known or not suspected by the Department.

Senkobo.—This is a native name for a skin disease of cattle, which has been described as a contagious impetigo. It appeared in a limited area of the Wankie district five or six years ago, and since then it has been more or less in evidence. It is believed to have been introduced from Northern Rhodesia, where it has been recognized for many years (see HORNBY, this *Bulletin*, 1920, Vol. 8, p. 232). In the form observed in the Wankie District the lesions generally appear on the hairless portions of the body and gradually extend, particularly to the back. Cases were observed in sheep and goats, in which the lesions were generally found on the head, and especially on the lips and ears. The Bont Tick (*Amblyomma hebraeum*) is suspected to be the transmittor; in the Wankie district the disease has been observed only where this tick is present. To effect a cure, treatment in the early stages is essential, and paraffin is stated to have given the best results.

Ephemeral Fever, or three-day sickness, of cattle was prevalent in several districts during the summer months and, as usual, there was practically no mortality.

An extraordinary complaint, known as *Sweating Sickness*, causes somewhat heavy mortality amongst calves during the rainy season. Treatment was of no avail, and 75 per cent. of affected animals succumbed.

In the Melsetter and Hartley districts the mortality amongst cattle due to *trypanosomiasis* was considerably less than during the previous year. In the Wankie district a large number of deaths occurred, but reliable statistics are not available.

Myiasis was not nearly so prevalent in cattle as during the previous year.

The total number of deaths among horses and mules during the year from *horse sickness* was reported to be 124, as compared with 89 during the previous year. The District Veterinary Surgeon of Victoria reported that more animals died between May and September than during the so-called horse-sickness season. In the Melsetter district the heaviest mortality occurred during the months of June and July. The results achieved by the process of immunization against this disease have proved to be most satisfactory, and it is held that in a few years time sufficient horses can be bred in Southern Rhodesia for local requirements.

There was no case of *glanders*.

The serious outbreak of *epizootic lymphangitis* which occurred in the Mazoe district in 1919 appears to have been satisfactorily dealt with. No fresh cases occurred amongst the animals involved, or elsewhere in the territory.

A schedule is attached showing the numbers of stock imported and exported.

REPORT OF THE VETERINARY BACTERIOLOGIST.

During the year, 1,827 preparations were received for diagnosis at the laboratory. East Coast fever was detected in 167, infectious abortion in 75, blackquarter in 133, anthrax in 16, trypanosomiasis in 5, and tuberculosis in 4.

Contagious Abortion in Cattle.—About 36 new areas were detected and the disease is far more widely distributed than was anticipated.

At a Conference of Provincial Officers of the Veterinary Department, held in August, it was decided that official quarantine of infected farms and herds was impracticable, and publication of notices regarding the disease was not desirable. It was considered that the only method at present available for limiting the spread of the disease lies in the power of veterinary officers to refuse permits for the removal of suspected cattle. The best method of controlling the disease is to educate and assist the public. In order to detect the nature of an outbreak, samples of blood should be collected, by Bevan's modification of the pipette method, to be tested by means of the agglutination test. Veterinary officers should warn and give advice to buyers contemplating purchase of animals likely to be infected. The reports received regarding the efficacy of the vaccine prepared at the veterinary laboratory were most satisfactory. The danger of the bull as a source of infection was discussed, and it was decided that all bulls in infected herds should be tested and destroyed if they showed a positive reaction. Non-reacting bulls should be removed from the herd for six months and vaccinated with "devitalized" vaccine. All female stock in an infected herd, together with calves should be vaccinated also in this way. New stock should not be introduced until a normal calf crop indicated immunity of the herd, and such new stock should be inoculated. "Queen" cows were considered to be a source of danger, and should be destroyed if they reacted to the test. The vaccine should be issued through the district veterinary surgeons in order that they may become aware of the existence of the disease in their district. Subsequent injections might be performed by the owner.

The so-called "devitalized" vaccine referred to was prepared in the laboratory by a method "intended to conserve as far as possible the integral properties of the organism and its toxins but to render them incapable of infecting pregnant animals or setting up a new focus of infection." The results obtained after the use of this product have been "such as to justify its general application." A table is given showing "the remarkable cessation of abortions in treated herds after the vaccination process." [The results are not entirely convincing inasmuch as no controls appear to have been left in the vaccinated herds.—ED.] It is maintained that "in untreated herds such favourable results have certainly not been observed; on the contrary the infection has continued with increasing severity." In 17 out of 21 outbreaks where the full treatment was applied abortion completely ceased. It was noted that a well-marked reaction occurred sometimes in the udder of vaccinated cows; 14,000 doses have been produced. Three injections of the vaccine are applied at intervals of one month between the first and second, and two months between the second and third periods. It would appear that in experimental cases the reaction to the agglutination test in infected animals became negative after such treatment.

Horse sickness.—Considerable progress was made in the inoculation of horses and mules against this disease. In addition to having discovered a virus-vaccine of suitable virulence Bevan claims to have determined a method whereby large quantities of it may be prepared. Inasmuch as the principle of immunization depends upon conveying to the inoculated animal a mild attack of the disease, it follows that the natural susceptibility or resistance of the animal is an important factor. The selection of a suitable virus is therefore difficult. The individual

susceptibility of animals is to a large extent unknown. Mules are known to possess a high degree of resistance and during the year 511 doses of vaccine were issued and applied to mules with but one death. A similar but less marked resistance is also possessed by young horses, and a course of inoculation was applied to 516 horses under 2½ years old with a loss of 28 animals, or 5·42 per cent. It was found that some of these young animals refused to react and thus derived no additional immunity, as evidenced by the fact that the animal is left, with increasing age, as susceptible to natural infection as an untreated animal. The resistance has been thought to be greatest in foals from "salted" parents and to be derived from the milk of the immune mother. It was therefore decided to postpone when possible the inoculation of young horses until they had been weaned.

Inasmuch as the natural immunity of an animal that does not react tends to die out, it is recommended that the inoculation be applied yearly. Seventy animals were re-inoculated during the year, with two deaths.

In 1919, 207 young horses were inoculated and reports have been received of the death of 12 only of these animals. Many of these deaths are attributed to careless treatment. Inoculated horses not infrequently suffer as the result of re-infection with a natural virus of a different strain to that against which they have been immunized, but the great majority of such animals recover if the reaction is detected and the animal is carefully looked after. It is noted that out of 286 inoculated police horses exposed during the year only two died of horse sickness. The greater mortality among privately owned horses suggests that they are not treated with equal care.

Whereas inoculation of young horses was entrusted to the District Veterinary Surgeons the immunization of older animals was carried out by Bevan himself. Two hundred and sixty-seven horses were thus inoculated, the average age being approximately five years, with a mortality of 7·86 per cent. The high mortality is attributed largely to deaths among the older horses. Condition is, however, a more important factor than age, horses in a good hard-working condition being the best subjects.

During the year Bevan inoculated 176 remounts for the British South Africa Police and three for the Northern Rhodesia Police. The work, however, was rendered more difficult by the occurrence of strangles. The death-rate was 7·6 per cent. as against 13·8 per cent. for the previous year. Forty-one horses imported for distribution to Cattle Inspectors were inoculated, with one death.

Piroplasmosis and Anaplasmosis (*Plasmoses*) *of Cattle.*—During the year vaccine was issued for inoculation against redwater and gall sickness on farms where dipping of cattle had been practised for some time and the ticks which transmit these diseases had been eliminated. The cattle bred upon such farms would therefore not contract these diseases during their early days and would subsequently possess no immunity during adult life. When removed to areas where dipping is not practised or where ticks have not been completely removed, they would thus be liable to contract the above diseases in an acute form. To provide against these disadvantages inoculation of calves with a standardized attenuated virus is recommended, but the demand for the vaccine does not appear to have been as great as was anticipated. Great improvement is claimed to have been effected in the method of inoculation by adopting a "double process," viz., by inoculating

animals first with a very mild virus, which partially protects them against a second virus that is sufficiently strong to render them immune against natural infection. This method was applied to valuable imported animals which could not be inoculated by the old single method without grave risk. Forty-three animals were thus treated, with but one death. The application of the method is also calculated to open up a good trade in Rhodesian pure bred and grade stock with Portuguese East Africa.

Blackquarter (*Quarter Evil*).—In the absence of adequate facilities for the manufacture of vaccines for the protection of stock against this increasingly prevalent disease, supplies of material had to be obtained from abroad. In the case of the so-called "germ-free" preparations, which are particularly susceptible to the effects of prolonged exposure to heat and light, this dependence on outside sources has obvious disadvantages. It was observed that in a considerable number of outbreaks in which such preparations were applied cases continued to occur. Re-inoculation of such herds did not always result in the cessation of the disease.

Autogenous vaccines were prepared at the laboratory from material collected by veterinarians in the field and were applied with considerable success, it is stated, in the treatment of a number of purulent affections such as mammitis, vaginitis of cattle, septic lymphangitis, lymphangitis following the bite of the "striped-leg" tick (*Hyalomma aegyptium*), strangles in horses, and pyaemia in dogs.

UNION OF SOUTH AFRICA. **Report of the Veterinary Division** [GRAY (C. E.), Principal Veterinary Officer] **for the Year ended 31st March, 1919.** Dept. Agric. Rept., with Appendices. Appendix 1. pp. 33–42. 1920. Cape Town: Cape Times, Ltd., Government Printers. [Price 7*s.* 6*d.*]

——. **Report of the Veterinary Division** [BORTHWICK (J. D.), Acting Principal Veterinary Officer] **for the Fifteen Months from 1st April, 1919, to 30th June, 1920.** 1921. Cape Town. [Price 4*s.*]

EAST COAST FEVER.

This disease continues to monopolize attention in many parts of the Union. The situation is generally improved, but nevertheless the progress made has been so slow that no hope is entertained of ultimately eradicating it. The most that can be expected under present conditions is to control the disease until such time as the farming community are prepared to make greater sacrifices, but difficulties were encountered owing to conditions arising out of the war, notably (1) the prohibitive price of fencing material, and (2) the increased cost of dipping materials. The influenza epidemic which occurred in October, 1918, also added considerably to the difficulties. There was, in addition, a shortage of veterinary staff due to an absence of members on active service. Among the farming community there is a progressive minority which is anxious to submit to more rigorous restrictions to get rid of the pest. The provision of a staff of officers, however, to enforce compulsory dipping in a district where such a measure would be inacceptable to a majority of residents is financially impracticable and so-called compulsory dipping at the prescribed interval is not likely to do anything more than reduce the numbers of the East Coast fever ticks to an extent that might render the early detection of outbreaks more difficult.

Some enthusiasts have suggested that the restrictions should be withdrawn and farmers left to protect themselves by their tanks, but the extreme scarcity of tanks in many parts points to the fact that their benefits have not yet been realized by many farmers, and, therefore, withdrawal of the present restrictions would immediately be followed by disaster to those sections of the community which practice regular dipping. The chief difficulties encountered are, apart from the unauthorized movement of cattle from or through infected areas, those which are due to the unfenced condition of farms or public roads, to the removal of stock for winter grazing, and to the universal practice of using cattle for transport purposes. It would be wise to introduce a zone system under which movements of cattle for transport purposes were only permitted within the boundaries of a more or less definite area. The presence of the native is held by many to constitute an insuperable obstacle to the eradication of the disease, but Gray does not share this view, as experience has shown that although it is often introduced into native areas by illicit movements and is sometimes difficult to eradicate, the average native responds fairly well to pressure judiciously applied by an official in whom he has confidence. The present East Coast fever position in Rhodesia, Swaziland, and many parts of the Transkei showed that the task of dealing with outbreaks in native areas is in many respects simpler than in districts occupied by a mixed population, where there is a constant demand for permits for the movement of cattle for transport and other purposes, and where a refusal does not necessarily suffice to prevent movement taking place.

Cape Province.—In the year 1918–19 there was only one outbreak, in a native location in the Dongwe area, obviously an extension from a previously existing centre. The disease was arrested by short-interval dipping; no deaths have occurred since May, 1918, and at present the Cape appears to be entirely free from the disease.

Transvaal.—In 1918–19 seven districts were infected—Barberton (11 fresh outbreaks), Pietersburg (6 fresh outbreaks), Zoutpansberg, Pietretief (5 fresh outbreaks), Carolina, Ermelo, and Waterberg. In the Barberton district a very serious setback was sustained, which could only be attributed to illegal movements and deliberate attempts to conceal the disease, with the result that the labour of years was undone. In 1919–20 a serious reverse was again experienced by the appearance of the disease in the Pretoria district, which had been free for many years. An outbreak was also reported in the Lydenburg district after a lapse of several years, close to the Barberton border. Fresh outbreaks were reported in Barberton, Pietersburg, Zoutpansberg and Pietretief. In Carolina and Ermelo, on the other hand, all quarantines were withdrawn.

Natal.—In 1918–19 slow progress was reported and an increase of staff for dealing with suspected outbreaks was needed. The work of providing dipping facilities for native owners was progressing steadily, but comparatively little progress was made in this respect in many parts. The number of outbreaks was 195, as compared with 247 for the previous twelve months. In 1919–20 there were again 115 fresh outbreaks, and the Senior Veterinary Officer believes that no appreciable progress is now being made in the eradication of the disease, although it is being controlled and a satisfactory increase in the number of cattle is taking place.

Transkei.—The progress made in combating the disease in native territory in 1918–19 exceeded Gray's expectations, especially in those areas where adequate dipping facilities were provided, but there are still areas in this territory where there is an insufficient number of tanks, and the natives are antagonistic. In 1919–20 it was again reported that it was in the Transkei and native territories that most progress was being made in eradicating the disease. Nine districts were declared free, and in four districts there was only one infected area in each district. Again, in six districts the outlook was good, and excellent progress was made in another district, but four districts were still regarded as wholly infected. Much of the progress in combating the disease has been due to the efforts of the General Native Council, which has persevered with its programme of tank erection.

Tuberculosis.

In 1918–19 no further advance in combating this disease was reported, but with the return of the veterinary staff it was hoped to take steps in this direction. Progress was also anticipated as a result of the passing of the Public Health Bill and education of the public on the health aspect of this disease in cattle.

Cape Province.—A considerable increase in the number of infected animals in the prohibited areas was reported in 1918–19, the percentage reacting having risen to 4·33 per cent. In 1919–20 the percentage of reactors found amongst cattle tested prior to being allowed to leave the prohibited areas—Cape and Stellenbosch—remained about the same. The disease remained very prevalent among housed cows in these areas.

Transvaal.—In 1918–19 it was concluded that there was no real falling off in the number of outbreaks and nine outbreaks were detected in 1919–20.

Natal.—The disease was discovered on five properties in 1918–19; 2,730 head of cattle were tested, of which 83 reacted. In 1919–20 there were eight outbreaks.

Orange Free State.—The test of a herd in 1918–19, which had been in contact with an Ayrshire bull found affected in the preceding year showed seven reactors. Twenty-one cases were reported from Johannesburg and Durban abattoirs—14 cattle and 10 pigs. In 1919–20 no outbreaks were located in the State, but as 58 cases were found at abattoirs among cattle from the Province there is no doubt as to its existence, but it was found impossible to locate in-contact animals.

Transkei.—In 1918–19 two cases were found among cows imported from Cape Town, and of 15 in-contact animals tested seven reacted and were destroyed. In 1919–20 two cases were again recorded, one at Kokstad and one at Umtata, both in imported Cape cows.

Imported Reactors.—In 1918–19, 360 imported cattle were tested at the quarantine stations in the Cape Province (Cape Town, Port Elizabeth, and East London). Twenty reacted and were destroyed, but of this number the existence of the disease could not be demonstrated in six animals. One hundred and forty-eight imported cattle were also tested at the Durban quarantine station and at Maritzburg; of which 17 reacted and were slaughtered. It was probable that the high percentage of animals which showed no lesions post-mortem after giving typical reactions was due to the fact that they had not yet had time to develop macroscopic lesions after exposure. The Pirbright testing station in England now enables importers to have their

animals officially tested before shipment. In 1919–20, 258 cattle passed through the Cape Province quarantine stations, six reacted and were destroyed, in one of which the existence of the disease could not be proved. At Durban 174 animals underwent the test ; 17 reacted, in two of which no lesions were found post-mortem.

Anthrax.

Cape Province.—In this Province anthrax is regarded as the most serious disease the veterinary staff has to contend with, and in 1918–19 it was responsible for more losses amongst farm stock than the total loss from all other contagious diseases. In spite of the warnings issued, stockowners have failed to realize the danger of skinning and cutting up the carcases of animals which have died suddenly without showing preliminary signs of illness. In this way the disease is spread, and, it is anticipated, will yet continue to spread until the rearing of stock will become impossible in areas particularly favourable for the perpetuation of infection, unless bi-annual inoculation of all classes of animals is resorted to. Again in 1919–20 the position was reported to be becoming increasingly serious. In many areas veld contamination appeared to have become so severe that heavy losses were sustained, even where owners lost no time in inoculating their stock, and repeated inoculations became necessary to check the mortality. In the Cape in 1918–19, 103 outbreaks were dealt with in the course of which 12,325 head of stock were inoculated. In the following year the disease was still prevalent everywhere except in the Karroo ; 179 outbreaks were reported, 636 animals died, and 4,354 were inoculated.

In the *Transvaal* in 1918–19 no fewer than 700 outbreaks were investigated, in the course of which 1,500 head of stock died and 67,500 were inoculated. In the following year 973 outbreaks were reported, 550 head of stock died, and 93,600 were inoculated.

In *Natal* in 1918–19 there were 54 outbreaks, with 413 deaths and 17,813 in-contacts inoculated. In the following year there were 96 outbreaks, with 413 deaths and 37,417 inoculated.

In the *Orange Free State* in 1918, 122 outbreaks were confirmed, with 524 deaths and 33,983 animals inoculated. In the following year it was regarded as by far the most serious of scheduled diseases ; the number of outbreaks increased to 378, with 3,545 deaths and 81,950 head of stock were inoculated.

In the *Transkei* in 1918–19 the disease was reported to be becoming increasingly prevalent ; there were 125 outbreaks, with 250 deaths and a total of 47,522 animals inoculated. In 1919–20 there were 265 outbreaks diagnosed and 52,887 animals were inoculated. Owing to the indifference of the native to the risks incurred in cutting up diseased carcases, which are frequently dissected and eaten, the difficulties of keeping the disease under control are very great.

Gray maintains that unless stockowners pay heed to the warnings and advice of the veterinary department, the Union will find itself at a very serious disadvantage when an endeavour is made to place its wool and hides on the world's markets, as it is scarcely to be expected that other countries will be prepared to run the risk attendant upon the handling of the products.

Glanders.

The situation is regarded as generally satisfactory; most owners recognize the importance of this disease and suspicious cases are reported to the authorities. In the year 1918–19, 16 outbreaks were dealt with in the Cape Province; 51 animals died or were destroyed, and 143 in-contacts tested. In 1919–20 there were 18 outbreaks. In the Transvaal in 1918–19 there were 8 outbreaks with 13 deaths, and 77 in-contacts tested. In 1919–20 there were again 8 outbreaks. In Natal there were no reported cases in 1918–19, but next year there was one rather serious outbreak in connection with which 13 died; 102 in-contacts passed the mallein test satisfactorily. In the Transkei there were 6 outbreaks with 9 deaths in 1918–19, and next year there were 2 outbreaks, with 8 animals destroyed. In the Orange Free State in 1918–19 there were 5 outbreaks with 19 deaths; next year there were 3 outbreaks and 9 animals destroyed.

Contagious Bovine Pleuro-Pneumonia (Lung Sickness).

The Union is still free from this disease, although it is extremely prevalent in the northern part of the Bechuanaland Protectorate, where, in 1918–19, about 52,000 in-contacts were inoculated and collected in numerous concentration camps. During the influenza outbreak in October 1918, large numbers of these cattle strayed, and it was feared that the disease might in this way be introduced into the Union. However, next year the Union still remained free from the disease, although cases were reported right on the northern border.

Equine Scabies (Mange).

In 1918–19 outbreaks occurred in various parts of the Union, but none of them was serious, and they were confined chiefly to equines that were not well looked after. The numbers of outbreaks were: Cape 67, Transvaal 71, Natal 1, Transkei 5, and Orange Free State 5. During the following year there was a recrudescence of the disease in the Cape Province, probably, it is stated, owing to the loss of condition among equines during the period of drought. There were 129 outbreaks, in the course of which 35 died and 334 were placed under observation or treatment. In the Transvaal there were 64 outbreaks, none of which was extensive, in Natal 2, in the Transkei 4, and in the Orange Free State 3.

Epizootic Lymphangitis.

In 1918–19 there were 13 outbreaks in the Cape, all in the Humansdorp district, and next year there were 4 outbreaks—3 in Humansdorp and 1 in Port Elizabeth; the improvement is attributed to the prompt destruction of infected equines, thorough disinfection, and isolation of in-contacts. There were no outbreaks in the other Provinces, except 2 in Natal in 1919–20.

Contagious Abortion of Cattle.

The regulations framed for dealing with this disease were withdrawn, as its arrest by legislative measures proved to be impracticable. The

Department now advises those who consult it as to the steps they should take for protecting themselves and checking the spread of outbreaks, but the policy of imposing quarantines of practically indefinite duration upon herd owners has been discontinued. Experiments in immunization are being continued. The disease is much more prevalent amongst both European and native stock in the Union and adjacent territories than the Department formerly had reason to believe.

Swine Fever.

This disease appears to have occurred in the Cape Province, where, in 1918–19, there were 11 outbreaks and next year 7 outbreaks, involving the death or destruction of 496 animals.

Dourine (Slapziekte).

In 1918–19 a number of farms in the Herbert district, where the disease had been prevalent in 1916, was visited, but no active cases of the disease were found, although losses on these farms were said to have been considerable. Specimens of blood from animals said to have recovered from the disease were sent to Canada to be tested. Two were negative, one positive, and the fourth doubtful. It appears that a few outbreaks of the disease occurred on farms in the South-west Protectorate. In 1919–20 the disease was still confined to the Hay, Herbert, and Barkly West districts of the Cape Province, but it was also suspected to exist in the Kuruman and Vrijburg districts, and possibly also in the Boshof district of the Orange Free State.

Rinderpest.

Reference has been made already in this *Bulletin* to the work of the Rinderpest Commission, which completed its operations in 1918 by establishing an immune belt of cattle in a stretch of country extending from Lake Nyasa to Lake Tanganyika; approximately 100,000 head of cattle were inoculated, with an average mortality of not more than 5 per cent. The mortality included deaths which occurred in a stretch of country in the vicinity of Lake Tanganyika where the cattle proved to be susceptible to redwater. Some members of the Commission narrowly escaped capture by Von Lettow's forces when they invaded Rhodesia a short time before they surrendered. As Von Lettow took a large number of cattle through the immune belt, some of which subsequently developed rinderpest after entering Rhodesian territory, it was fortunate that the Commission was able to deal with the situation which thus arose. Otherwise the work of the Commission might have been completely undone. After the withdrawal of the Commission, patrols were continued along the northern border of Nyasaland and Rhodesia, and in the 1919–20 Report no extension of the disease south of the belt is recorded.

Non-Proclaimed Diseases.

In 1918–19, in the Cape, lamziekte was prevalent on the "sour" veld areas which did not obtain good summer rains.

There was scarcely any horse sickness or blue tongue (in sheep), but in the border districts there was considerable mortality amongst small stock from internal parasites after the wet season of 1918. In the Transvaal blackquarter was very prevalent and caused heavy losses, especially in native locations. Six hundred and sixty-six mules were inoculated against horse sickness in 1918–19, with a total loss of three animals. In the Orange Free State blue tongue was mild and 41,112 doses of vaccine against this sheep disease were issued; out of 18,616 sheep concerning which reports were obtained, there was a mortality of 49. All animals, however, were visibly ill after inoculation. A condition known as white liver (apparently in sheep) is noted and believed to be due to the ingestion of some plant.

Anaplasmosis was fairly prevalent in the Orange Free State and the gross character of tick infection on many farms in this State is commented upon.

Owing to the prevalence of wire-worm (*H. contortus*) the demand for the Government remedy (see VEGLIA, this *Bulletin*, 1920, Vol. 8, p. 26), continued to increase. Favourable reports as to its effects were received.

Three Days' Sickness (Ephemeral Fever in Cattle) was prevalent in the Midland districts towards the end of 1919 and led indirectly to the death of considerable numbers of cattle, which had become reduced in condition owing to the drought.

Again several outbreaks of lamziekte were reported from the "sour" veld coastal districts during the early summer months.

In the 1919–20 Report, blue tongue is again stated to have been not particularly prevalent, but several outbreaks of heart water were reported from Somerset East, Albany, and Cradock divisions; these are attributed probably to the movements of sheep to coastal districts to escape the drought, where they probably picked up infected bont ticks. In the Transvaal, Natal, and Orange Free State there was no non-proclaimed disease of any importance during this year.

In the Transkei, blue tongue was very prevalent towards the end of the summer and a considerable mortality resulted therefrom, as very little inoculation had been carried out before the summer commenced.

Experiments on dunziekte or "grass staggers" are being continued at Usherwood, near Kokstad, with, it is stated, interesting results. Muzzled horses running on an area that had a bad reputation for this disease remained free from it, but a considerable number of animals so muzzled developed osteoporosis.

Wire-worm infection was very prevalent in 1919–20 amongst native sheep. Horse sickness was confined to the Port St. John's district, where numerous deaths were reported.

Meat Export.—In the 1918–19 Report the prospects of an expansion in this trade were stated to be encouraging, although the average quality of the meat killed for export is somewhat inferior on account of the defective conformation of the animals and lack of exact knowledge of the requirements of overseas buyers. Also a shortage of efficient or of effectively insulated trucks handicaps up-country killers, Again in 1919–20 meat export was carried on "to a limited extent" as indicated by the Export Return.

Importation of Stock.—Owing to the prevalence of foot-and-mouth disease in Holland, importation of cattle, sheep, goats, and pigs from

that country has been prohibited until further notice. Again, in 1919–20, arrangements were made for the admission of Rhodesian cattle into the Union for re-stocking purposes, in order to meet the needs of settlers taking up land in the Northern Transvaal, where climatic conditions are unfavourable for cattle which are subject to redwater and gall sickness. A large camp was thus fenced in near Liebig's Drift, where cattle were confined for a month before they were released. During the year 67,390 head of cattle were introduced into the Union for slaughter purposes and 29,991 for re-stocking.

PHILIPPINE ISLANDS. **Reports of the Veterinary Division** [YOUNGBERG (Stanton), Chief Veterinarian] **for the Years 1918–19–20.** *Eighteenth, Nineteenth, and Twentieth Annual Reports of the Bureau of Agriculture for the Fiscal Years ended December 31st, 1918, 1919* and *1920.* Manila: Bureau of Printing.*

Rinderpest.—This disease appears to be the most serious cause of losses among the cattle of the Philippine Islands. The number of fresh cases reported during the three years 1918–19–20 was 21,586, 16,228 and 22,442, and the number of deaths 15,747, 11,085 and 16,911, respectively. The actual losses were probably larger than these figures would indicate as, owing to a shortage in the veterinary staff, the records are not complete. The present epizootic first assumed serious proportions in 1916, and, although there are signs that it is abating in virulence, the position is still far from satisfactory as compared with the last normal year, 1915, when the number of deaths was only 2,305. The measures adopted to control the spread of the disease have consisted of strict quarantine combined with the use of serum. It was found that the use of serum alone was not sufficient to prevent the disease from spreading. For the purposes of control the Islands have been divided into districts, and a qualified veterinary surgeon assigned to each with a small force of live stock inspectors under his control. Immunization by simultaneous inoculation has also been practised as far as circumstances would allow, and the results obtained by this method have been very satisfactory, less than 1 per cent. of the immunized animals subsequently contracting the disease. Some difficulty has been experienced in obtaining a constant supply of animals for inoculation owing to the fact that the inhabitants become indifferent as soon as the disease shows signs of abating in their districts.

Foot-and-Mouth Disease.—The disease was introduced in 1918 in a very virulent form by cattle imported from French Indo-China. The whole consignment was placed in strict quarantine and slaughtered immediately, but in spite of all precautions the disease spread to the native cattle and resulted in considerable loss and inconvenience. It continued throughout the whole of 1919, but during 1920 there were only two outbreaks which soon became extinct.

Haemorrhagic Septicaemia.—This disease is fairly widespread and usually occurs at the beginning of the rainy season, but does not cause very serious losses.

* Abstracted by Mr. T. J. Bosworth, B.Sc., D.V.S.M., M.R.C.V.S.

Surra.—Owing to the heavy demands of the anti-rinderpest campaign it has not been possible to undertake any measures against surra. The disease, however, is very widespread.

Contagious Abortion.—During the year 1920 several suspicious cases occurred in a Manila dairy. The disease had not previously been reported in the Philippines.

Tuberculosis.—This disease appears to be practically non-existent amongst native cattle and carabaos. Several cases have occurred among some Berkshire pigs imported from U.S.A. The intradermal tuberculin test has been employed for diagnosis and has given good results. Measures are being taken to stamp out the disease.

Research Work.—Attempts have been made to locate the various seats of rinderpest virus in the animal body by making extracts from various organs and inoculating them into susceptible animals after storing for various periods of time. The organs in which the virus is especially situated proved to be the liver, spleen, lymph glands, heart, fourth stomach, caecum and colon. Extract of skeletal muscle was not infectious. The virus appears to multiply, therefore, inside the tissue cells and the virus in the blood stream is merely a surplus which is thrown off from these cells. Organ extracts can be used in the place of virulent blood for simultaneous inoculation and also for hyperimmunization, and thus a much larger supply of virulent material is obtainable from any one animal. A 0·5 per cent. phenol extract of liver, spleen and lymph gland will hold the virus of rinderpest in a virulent form as long as 55 days.

The report claims that a "vaccine" for rinderpest has been prepared, which gives promising results as a preventive. [The method of preparation is not given.—J.T.E.] Means have been found of keeping it potent for 60 days, so that it can be thoroughly tested before issue. In the laboratory tests it was administered to highly susceptible animals in two doses of 10 cc. each with an interval of from 7–10 days. One week after the last injection the test animals were exposed to infection, being inoculated subcutaneously with virulent blood and placed in contact with sick animals. All remained healthy. In field tests the dose given was 20 cc. for adults and 8–15 cc. for young animals. In all, 4,433 animals have been vaccinated in districts where rinderpest is rampant, and this procedure is said to have contributed to a speedy disappearance of the disease.

A vaccine for *Hog Cholera* is being developed along similar lines, and has so far given promising results. In the case of hogs the two vaccines are mixed so as to afford protection against both diseases.

An outbreak of *Anaplasmosis* was diagnosed in Lipa Batangas among cattle, but carabaos appear to be immune.

Book Review.

Pillers (A. W. Noel). [F.R.C.V.S., F.Z.S.] **Notes on Mange, and Allied, Mites for Veterinarians.**—pp. xii+110. With 68 figs. Demy 8vo. 1921. London: Baillière, Tindall & Cox, 8, Henrietta Street, Covent Garden. [Price 12*s.* 6*d.* net.]

This little book will no doubt prove useful to many besides the professional veterinarian. It deals briefly with the wholly parasitic mites that commonly attack the animal epidermis, and also the food-mites which, as is well known, not only may get on to animals but, when numerous, may sometimes become parasites of their fortuitous hosts; nor are the useful forms, such as Cheyletus, that prey upon their harmful fellow-mites, forgotten. It also contains practical directions for treating mange and scab.

A. Alcock.